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Author: Dr. Alice Brunello
CISAS "G. Colombo" - University of Padova, Italy, alice.brunello.3@studenti.unipd.it

Mr. Sergio García González
SENER, Spain, sergio.garcia@aeroespacial.sener
Dr. Andrea Valmorbida
University of Padova - DII/CISAS, Italy, andrea.valmorbida@unipd.it
Dr. Giulia Sarego
University of Padova, CISAS – "G. Colombo" Center of Studies and Activities for Space, Italy, giulia.sarego@unipd.it
Dr. Lorenzo Olivieri
CISAS "G. Colombo" - University of Padova, Italy, lorenzo.olivieri@unipd.it
Dr. Simone Fortuna
University of Padova - DII, Italy, simone.fortuna@studenti.unipd.it
Prof. Enrico C. Lorenzini
Università degli Studi di Padova, Italy, enrico.lorenzini@unipd.it

DEPLOYMENT FUNCTIONAL TESTS OF AN ELECTRODYNAMIC TAPE FOR SPACE DEBRIS MITIGATION

Abstract

The space community is studying new strategies and potential alternatives to the traditional chemical propulsion to address the problem of orbital debris. In this context, Electrodynamic Tethers (EDTs) are a promising option for the orbital debris mitigation because they generate forces without discharging propellant, thus with a minimal impact on the space environment. The H2020 Future Emerging Technologies FET OPEN Project E.T.PACK focuses on the development and construction of a Deorbit Kit prototype based on electrodynamic tether technology for deorbiting end of life spacecrafts using a tape with segments made of different materials. The purpose is to generate drag forces (i.e. Lorentz forces) by exploiting a conducting tape immersed in the Geo-magnetic field and ionosphere.

As project partner, the University of Padova has conducted specific deployment tests on representative tape lengths and velocities to evaluate the system functionality. These tests were meant for checking the ability of the Deployer Mechanism, that is a fundamental component of the Deorbit Kit prototype, to deploy smoothly different sections of tape made of 40-μm-thick bare Aluminum and 50-μm PEEK.

Those materials were investigated separately, since they have very different mechanical properties, and tests were carried out with PEEK and Aluminum joined in series as in the flight configuration. The goal of these tests was to assess the critical points related with the extraction of tapes, by evaluating the status of each tape segment after the deployment tests with a particular attention to the Aluminum. Indeed, the thin Aluminum is sensitive to tearing and the extraction of the tape from the coils must be smooth. In this regard, the internal part of the Deployer Mechanism was carefully studied and designed in order to prevent any damage to the tape.

In this paper, we will show the experimental setup, with a particular attention to the main components for the correct tape extraction. A second part will focus on the method and the results of the experimental campaign in which tapes with different thicknesses and flexibilities were deployed smoothly in the range of

velocity of interest. The tests were also conducted with different orientations of the Deployer Mechanism in order to investigate the role of different gravity loads that cover the less severe situation of weightlessness. With these tests we demonstrated that the Deployer Mechanism in its present configuration is capable of deploying the tape safely at all operational speeds and independently of its attitude.