Paper ID: 14898
oral
student

SPACE DEBRIS SYMPOSIUM (A6)
Mitigation and Standards (4)

Author: Mr. Denis Zanutto
CISAS – "G. Colombo" Center of Studies and Activities for Space, University of Padova, Italy, denis.zanutto@studenti.unipd.it

Dr. Giacomo Colombatti
CISAS – "G. Colombo" Center of Studies and Activities for Space, University of Padova, Italy, giacomo.colombatti@unipd.it
Prof. Enrico C. Lorenzini
Università degli Studi di Padova, Italy, enrico.lorenzini@unipd.it
Mr. Antonio Sánchez-Torres
Universidad Politécnica de Madrid, Spain, antonio.sanchezt@upm.es
Mr. Riccardo Mantellato
CISAS – "G. Colombo" Center of Studies and Activities for Space, University of Padova, Italy, riccardo.mantellato@studenti.unipd.it

ORBITAL DEBRIS MITIGATION THROUGH DEORBITING WITH PASSIVE ELECTRODYNAMIC DRAG

Abstract

The increase of orbital debris and the consequent proliferation of smaller objects through fragmentation is driving the need for mitigation strategies that address this issue at its roots. The present guidelines for mitigation point out the need to deorbit new satellites injected into low Earth orbit (LEO) within a 25-year time. The issue is then how to deorbit the satellite with an efficient system that does not impair drastically the propellant budget of the satellite and, consequently, reduces its operating life. We have been investigating, in the framework of a European-Community-funded project, a passive system that makes use of an electrodynamics tether to deorbit a satellite through Lorentz forces. The system collects electrons from the ionosphere at its anodic end (the conductive tether itself left bare) and emits electrons through a plasma contactor at the cathodic end. The current that circulates in the tether produces the Lorentz drag force through the interaction with the Earth's magnetic field. Power can also be tapped from the tether for running the cathode and other ancillary on-board equipment. The deorbiting system will be carried by the satellite itself at launch and it will be deployed from the satellite at the end of its life. From that moment onward the system operates passively without requiring any intervention from the satellite itself. The paper summarizes the results of the analysis carried out to show the deorbiting performance of the system starting from different orbital altitudes and inclinations for a reference satellite mass. Results can be easily scaled to other satellite masses. The results have been obtained by using a high-fidelity computer model that uses the latest environmental routines for magnetic field, ionospheric density, atmospheric density and a 4x4 gravity field model. The tether dynamics is modelled by considering the tether flexibility. The tether temperature is computed dynamically by a thermal model that utilizes all the major input fluxes and the thermal flux emitted from the tether. The results shows that a relatively compact and light system can produce a complete deorbit of a relatively large satellite with deorbit times ranging from a month to less than a year starting from high LEO with the best performance occurring at low orbital inclinations.