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LONG-TERM SIMULATIONS TO ASSESS THE EFFECTS OF DRAG AND SOLAR SAILS ON THE SPACE DEBRIS ENVIRONMENT

Abstract

Solar and drag sailing and electrodynamic tethers have been proposed as passive end-of-life deorbiting methods, and technological demonstrators are under development. In the drag dominated regime the required area-to-mass-ratio for deorbiting a sail spacecraft is primarily dependant on the semi-major axis, growing exponentially with increasing altitude. In the solar radiation pressure dominated regime, the required area-to-mass ratio strongly depends on both semi-major axis and inclination of the initial orbit. The deorbiting phase, at least in the first phase, is achieved on an elliptical orbit, not a circular orbit like in the case of drag sail with inward deorbiting. Another technology for end-of-life satellite deorbiting is represented by electrodynamic tethers. In general, increasing the cable length as well as its cross section increases the deorbiting force. This paper is focus on the last part of a study, funded by the European Space Agency, aimed at assessing the net effect of using sails for passive deorbiting at the end of life. Their increased cross-sectional area will decrease the deorbiting time; however, it will increase the collision risk over the deorbiting phase with respect to a standard satellite. In case a sail is involved in a collision, a new fragmentation model is used, which considers also large and soft appendages to characterise the resulting fragments distribution. The results of long-term simulation of the whole space object population environment with SDM are used to show the net effect of using these strategies.