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AN ATTITUDE-INDEPENDENT PARACHUTE FOR DE-ORBITING INOPERATIVE SATELLITES

Abstract

Space debris is a growing concern in low Earth orbit (LEO), with the potential to pose a threat to all active satellites and spacecraft. One of the key ways to mitigate this problem is to ensure objects in LEO are removed from orbit at the end of their useful lifetimes. Due to the low atmospheric drag on satellites in LEO, deorbiting can take upwards of 100 years naturally, despite their lifetimes being much smaller in the harsh space environments. As such, a reliable way to deorbit satellites is required. With large satellite constellations increasing each year, Liou et al. (2018) simulated that a post-mission disposal reliability of 99.9Various shapes and materials for a 3D, attitude-independent drag device are explored as part of this study, simulated through CNES STELA and ESA DRAMA, to find the optimal configuration. The device aims to enable deorbiting for tumbling, out of control satellites, while staying mass efficient. It will also incorporate a backup timing mechanism to start deployment after a set period, removing the reliance on as many subsystems as possible. Based on the analysis, an open tetrahedron was found to be the optimal solution, deploying with inflatable, rigidisable aluminium cylinders, allowing it to survive small debris impacts. CFRP or metal booms were found to have a similar mass, but with a higher area density, potentially causing catastrophic collisions if they impacted a satellite. A cool gas generator was included to inflate the cylinders, which has been previously stored for a combined 7 years on the ground and in space before correctly generating. The device requires further testing to validate the reliability and feasibility for practical implementation but offers a promising, implementable solution for reducing the collisional debris growth, and solving one of the largest current issues in space.