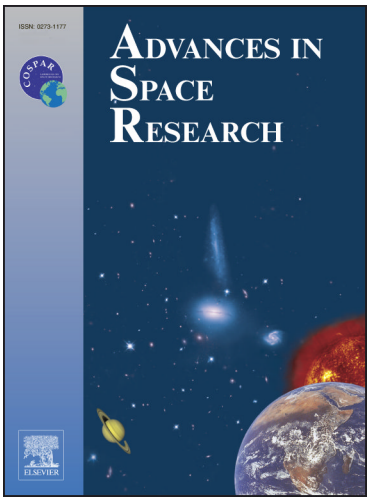

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Optimal Earth's reentry disposal of the Galileo constellation

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Abstract

Nowadays there is international consensus that space activities must be managed to minimize debris generation and risk. The paper presents a method for the end-of-life (EoL) disposal of spacecraft in Medium Earth Orbit (MEO). The problem is formulated as a multiobjective optimization one, which is solved with an evolutionary algorithm. An impulsive manoeuvre is optimised to reenter the spacecraft in Earth's atmosphere within 100 years. Pareto optimal solutions are obtained using the manoeuvre Δv and the time-to-reentry as objective functions to be minimised. To explore at the best the search space a semi-analytical orbit propagator, which can propagate an orbit for 100 years in few seconds, is adopted. An in-depth analysis of the results is carried out to understand the conditions leading to a fast reentry with minimum propellant. For this aim a new way of representing the disposal solutions is introduced. With a single 2D plot we are able to fully describe the time evolution of all the relevant orbital parameters as well as identify the conditions that enables the eccentricity build-up. The EoL disposal of the Galileo constellation is used as test case.

Keywords: Trajectory Optimization; End-of-life disposal; Navigation Constellation; Space debris; Long-term propagation;

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