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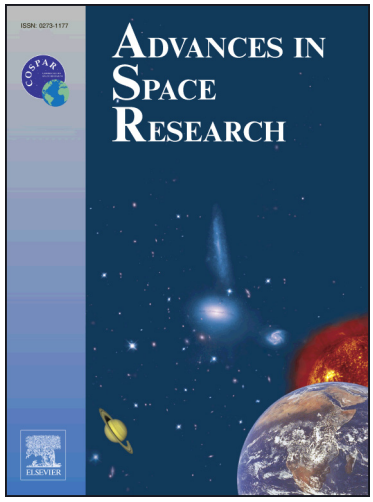

Effect of perturbations on debris-to-debris orbital transfers: a quantitative analysis

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Effect of perturbations on debris-to-debris orbital transfers: a quantitative analysis

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Abstract

We investigated the applicability of the Lambert solver (Izzo, 2014) for preliminary design of Multi-Target Active Debris Removal missions. Firstly, we computed ≈25 million debris-to-debris transfers using the Lambert solver for selected sets of debris objects in Low Earth Orbit, Geostationary Transfer Orbit, and Geosynchronous Orbit. Subsequently, we propagated the departure states of the Lambert transfers below selected ΔV cut-offs using the SGP4/SDP4 propagator (Vallado et al., 2006). We recorded the arrival postion and velocity error vectors incurred by neglecting perturbations and analyzed the results for each orbital regime. Our results indicate that perturbations can play a significant role in determining the feasibility of debris-to-debris transfers. By using the Lambert solver and neglecting perturbations, the errors in the arrival position and velocity for individual legs can be large. The largest errors were obtained for transfers between debris objects in Sun-Synchronous Orbit ($\mathcal{O}(100)$ km error in magnitude of position vector and $\mathcal{O}(0.1)$ km/s error in magnitude of velocity vector). Hence, solely employing the Lambert solver to rank transfer legs could lead to incorrect choices for sequencing of multi-target trajectories. This is particularly relevant for transfers in Low Earth Orbit, where the effects of perturbations are the strongest.

Keywords: space debris; active debris removal; mission design; orbital perturbations; lambert solver; sgp4

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