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BALLISTIC SCHEME SELECTION FOR MANEUVERING INSIDE A CONSTELLATION WITH CONTINUOUSLY CHANGING CONFIGURATION

Abstract

Space vehicle's maneuvering schemes for maintenance and replenishment of constellations with fixed geometry are well studied and have already become standard nowadays. However developed usual schemes can't be utilized if constellation's structure changes in time speaking about frequently maneuvering vehicles or about groups of large-dimensioned space debris. The orbital parameters' values of such objects are similar but still differ one from another. This leads to diverse velocity of orbital precession caused by the Earth gravity field non-centrality. So the configuration of a constellation changes while an active vehicle executes a flight between the involved objects and it is to be taken into account when calculating the values of impulses. This study is devoted to ΔV function dynamics investigation in case of vehicle's consecutive flights from one element of non-structured constellation to another. It is assumed that the initial and final orbits have similar but different values of major semi-axis, little inclination deviations are possible; RAAN difference value is not limited. Eccentricity difference is supposed to be very small so it doesn't change the obtained solution in principal and can be neglected while carrying out ΔV estimations. The offered ΔV optimization is based on usage of a drift orbit with a value of orbital precession velocity not equal to the same characteristics of initial and final orbits. Maneuvering vehicle's operator is supposed to set the duration of staying at the drift orbit. The analytical relations were found which determine a number of circuits at the drift orbit which is a compromise between time and ΔV costs for coplanar transitions. The attendant effects were analyzed in case of non-coplanar flights which if used allow ΔV costs' significant minimization especially speaking about the orbits with small RAAN deviation. It is found that there is a chance to change the RAAN more but with less ΔV due to delta-v curve's damping oscillations around the increasing locally linear function. If there is a difference in semi-major axis between the initial and final orbits a ΔV minimum point can be found regarding the concrete values of other orbital parameters. The influence of the RAAN and inclination difference on ΔV function was especially studied. The discovered effects concerned with ΔV dependence on various values of orbital parameters' deviations can be applied either in constellations' maintainance and replenishment or in the problem of large-dimensioned space debris collection helping to create the optimal strategy for artificial non-functioning objects flyby.