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OPTIMIZATION OF FLYBY SCHEMES IN THE FRAMEWORK OF ADR MISSION IN LEO

Abstract

The comparative analysis of geometry and mass of last stages of known launch-vehicles makes it possible to emphasize 5 compact groups of large-size space debris (LSSD) in LEO. Each group is characterized by the proximity of orbital inclinations of objects that constitute this group (71, 74, 81, 83, 97-100 degrees). Inside a group the variation of semi-major axis is located in 30-90 km interval except group #5 formed by sun-synchronous orbits. The necessity of correction of the RAAN will be the most critical in terms of total ΔV: the required orbital plane's rotation while flying between two neighbour objects will be 10-15 degrees in average, so the usage of the special drift orbit is actual. There are two world-wide known approaches to de-orbiting which were specially developed for LSSD objects. They both deal with an active SV-collector which would execute flights between the objects. The first approach assumes an active SV equipped with detachable units (thruster de-orbiting kits, TDK) with their own propulsion and storage of fuel to perform a breaking velocity impulse. After the physical connection with LSSD object is done these TDKs are to be installed on the object to ensure its further transition to specially calculated disposal orbit (DO). An active SV will stay at the orbit of this object and then flies to the next object. If the second approach is taken into consideration an active SV is to dock with an object and using its own propulsion transfers all the assembly into DO. An active SV stays at this DO until the plane of DO and the orbital plane of the next object will not become congruent in terms of the RAAN and then the flight to the next orbit is to be executed. The report contains a comparison of efficiency of two main de-orbiting approaches in terms of total ΔV, mission duration, quantity of re-fueling operations and maximum quantity of TDK onboard. The analysis of results made it possible to formulate the required life-time of an active SV and its necessary reserve of ΔV for one charge. The optimal value of maximum number of TDKs onboard was determined. The choice of required type and parameters of DO allowed the calculation of amounts of fuel for each TDK.