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MARTIAN MOONS EXPLORATION TRANSFER ANALYSIS BETWEEN PLANAR AND SPATIAL QSOS AROUND PHOBOS

Abstract

Quasi-satellite orbits (QSO) are considered stable retrograde parking orbits around Phobos for JAXA's upcoming robotic sample return mission MMX [1]. During the proximity operations of MMX, the spacecraft inserted in a high altitude QSO will gradually descend to lower altitude QSOs with suitable transfer and station-keeping techniques between different relative QSOs. Preliminary analysis of two-impulsive planar transfers between relative retrograde orbits utilizing the bifurcated QSOs families is studied to estimate the V costs and Time of Flights of the transfers [2]. In spatial transfers, trajectories utilizing the invariant manifolds of unstable 3D-QSOs connecting planar QSOs are studied [3]. However, these intermediate 3D-QSOs are weakly to highly unstable and require additional station-keeping strategies to perform MMX scientific observations [4]. These transfer trajectories have a longer flight time and might require minor correction maneuvers along the transfer paths. In this paper, an orbital maintenance strategy [5] that suppresses and eliminates linear dynamical instability of the unstable 3D-QSOs has been considered for shortlisting feasible 3D-QSOs for high-latitude observations. Differently from the previous works on the QSO transfers [2,3,6], we utilize the initial guesses found through the preliminary results [2,3] that provide two-impulsive transfer ΔV execution points as finite burns and optimize the transfers between relative QSOs around Phobos. Besides, this paper proposes introducing an indirect optimization method that uses the primer vector [7] of the transfer trajectories to investigate whether intermediate maneuver or initial/final coasting times along the trajectories can minimize the total ΔV cost between the transfers.

References

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