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Comparison of Transfer Orbits in the Restricted Three and Four-Body Problems

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Abstract: The restricted three-body problem and the quasi-bicircular problem are the dynamical systems used as models in this paper. The first one describes the motion of one massless body in the potential field of the two massive bodies revolving in circular orbit around their center of mass. The quasi-bicircular problem (QBCP) is a variation of the restricted four-body problem, where the three massive primaries move in a quasi-circular motion around their center of mass. Here, we consider the Earth–Moon as primaries of the restricted three-body problem (RTBP) and the Earth–Moon-Sun as primaries of the QBCP. One of the spatial periodic solutions around the collinear point are known as halo orbits. Our objective is to determine, in both models, transfer orbits from a parking orbit around the Earth to a halo orbit. We apply the two-point boundary value problem, where the boundary points are on the parking and on the halo orbits. Since there is no Keplerian orbit involved in this transfer method, we have called it an adapted Lambert's problem. We compare the total velocity increment obtained with this method applied to both dynamical models. We find that there is a positive solar contribution decreasing the total impulse.

Keywords: *Restricted three-body problem; quasi-bicircular problem; halo orbits; impulsive transfer orbits; two point boundary value problem.*

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