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TRAJECTORY DESIGN FOR THE MOON DEPARTURE LIBRATION POINT MISSIONS IN FULL EPHEMERIS MODEL

Abstract

The lunar probe may still has some remaining fuel after completing its predefined Moon exploration mission and be able to carry out some additional scientific or technological tasks escaping from the Moon orbit. The Moon departure libration point mission is concerned about in this work. At first, the possibility of the spacecraft orbiting the Moon to escape the gravitational pull of the Moon is analyzed. And two different dynamical models are employed in the trajectory design for different purpose. The Earth-Moon-spacecraft restricted three-body system is used when determining and computing the halo orbit associated with the Earth-Moon libration points. While the state variables of the spacecraft are integrated in the framework of an accurate full ephemeris dynamical model, which includes not only the gravities of the Sun and the planets but also the non-uniform motion of the Moon relative to the Earth. With the Particle Swarm Optimization algorithm applied, the trajectory design for the transfer from the Moon-centered orbit to the Earth-Moon L1 halo orbit is investigated in the full ephemeris model. And because of the inherent instability of the halo orbits and the perturbations, the station-keeping strategies for the Earth-Moon halo orbits are studied. Moreover, some special orbits of the Earth-Moon system, homoclinic orbits and heteroclinic orbits, are found. Taking the tracking conditions into account, two possible schemes for the Moon departure libration point mission are presented.