Paper ID: 34340
student

ASTRODYNAMICS SYMPOSIUM (C1)
Orbital Dynamics (1) (6)

Author: Mr. Yi Qi
Beihang University, China, qiyi299792458@sina.com

Mr. Shijie Xu
China, starsjxu@163.com
Dr. Rui Zhong
Beijing University of Aeronautics and Astronautics (BUAA), China, zhongruia@163.com

TRANSFERS BETWEEN LIBRATION POINT ORBITS USING LUNAR GRAVITY ASSIST

Abstract

The traditional transfers between the libration point orbits are usually based on the invariant manifolds of the circular restricted three-body problem (CRTBP) without use of any propulsive system. However, since the Jacobi constant of the spacecraft is changeless along the invariant manifolds, the transfer between the libration point orbits with different Jacobi constants is a mission impossible in the CRTBP. In this paper, using the lunar gravity assist (LGA), we propose a design method in the Sun-Earth-Moon-spacecraft restricted four-body problem (RFBP) to construct the transfers between the Sun-Earth/Moon libration point orbits with different Jacobi constants. First of all, the RFBP is simplified into two coupled CRTBPs of the Sun-Earth/Moon and Earth-Moon systems by the sphere of influence of the Earth-Moon system (SOIEM). Then using the Poincare sections of the Sun-Earth/Moon invariant manifolds on the SOIEM and the geometry properties of the LGA orbits on the SOIEM, we can choose the appropriate patched points. The corresponding patched transfers can further be obtained under the two coupled CRTBPs. Using those patched transfers as the initial guesses, a design method is proposed to construct the transfers between the Sun-Earth/Moon libration point orbits with different Jacobi constants in the RFBP. Based on this design method, if the lunar fly-by is used once, we can construct the cross-level heteroclinic connections between the libration point orbits. Furthermore, if we use the lunar fly-bys twice, the cross-level quasi-homoclinic connections between the libration point orbits can be obtained. In addition, the numerical calculation indicates that compared with the traditional transfers, the transfers we obtained can efficiently save the fuel costs in some special space missions.