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A STUDY OF THE TRANSFER TRAJECTORIES TO HALO ORBITS USING STABLE MANIFOLDS CONSIDERING LAUNCH CONDITIONS

Abstract

Preliminary mission design of transfer trajectories to the Halo orbits using stable manifolds for the SPICA mission was studied. The SPICA (SPace Infrared telescope for Cosmology and Astrophysics) will be the first Japanese Lagrange point mission and this next-generation infrared astronomical satellite is likely to be launched into a Halo orbit around Sun-Earth L2 point in 2018. The vicinity of L2 point is an ideal place for the infrared astronomy because the radiative cooling could be effective and long observable area could be obtained due to the stable geometrical condition with respect to the Sun and Earth. Besides, placing the satellite on the Halo orbits allows us to keep the satellite away from the eclipse region because the L2 Halo orbit is not hidden inside the shadow of the Earth.

For designing trajectory in a conventional way, there are some critical operations such as the attitude control and insertion impulse maneuver to the final orbit at the arrival. To avoid these critical operations, in this study we discuss the utilization of the stable manifolds, which are a dynamical characteristic of three-body model and converge to the Halo orbit naturally, for the transfer from the Earth to the Halo orbit. Firstly, the availability of using the stable manifold in the case of the given launch conditions such as the perigee altitude and the inclination to the equator is investigated. Next, the launch window in that case is also studied. Consequently, there are four occasions of the launch for the transfer to the Halo orbit by using the stable manifold, correspond to the so-called fast and slow transfer, if the Halo orbit's amplitude of z axis (Az) is more than about 0.35 million km. Moreover, the launch window could be expanded to approximately 70 days by varying the size of the nominal Halo orbit from 0.35 to 0.45 million km.