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FORMATION FLYING AROUND LIBRATION POINTS OF CIRCULAR RESTRICTED THREE BODY PROBLEM WITH SMALL $$

Abstract

The success of Hayabusa of JAXA draws more and more attention to asteroid exploration in recent years. Various plans have been proposed and implemented. Long period observations of an asteroid are required to obtain its detailed information. However, it is impossible for the explorer to orbit an irregularly shaped asteroid. In this case, formation flying with the asteroid is necessary. Different strategies of formation flying should be adapted for different conditions: when the gravity of the asteroid could be neglected, C-W equation is applicable; when its gravity can't be ignored, the formation flying can be based on the dynamics of libration point L1 in the CRTBP (circular restricted three body problem).

This paper studies the dynamics and control strategies of collinear libration point L1 of CRTBP with small μ. The CRTBP is an appropriate dynamical model for the three body problem system of the Sun, the asteroid and the spacecraft, and figures out the features of the halo orbits in this kind of CRTBP. The magnitude of μ, which is a parameter weighing the gravity of the asteroid, has a significant effect on the stability of the periodic orbit. Orbit control for station keeping of the spacecraft is also discussed and the relationship between energy consumption and the parameter μ is presented. Theoretical analysis and numerical simulations show that formation flying with an asteroid on the basis of halo orbit around libration point is applicable in asteroid exploration. This strategy, in some cases, consumes less orbit control than that of the strategy based on C-W equations.