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TRAJECTORY DESIGN TO TRIANGULAR LIBRATION POINTS BASED ON RESONANT ORBITS

Abstract

The Sun-Earth triangular Lagrange points L_4 and L_5 are important locations in scientific field. For example, the Sun-Earth L_5 provides an ideal location to monitor the space weather and the Sun-Earth L_4 and L_5 are also known as a place of Earth Trojans and space dust. However, it needs more energy to reach the triangular points L_4 and L_5 because the triangular points exist on the high potential surface.

In this study, we use resonant orbits to transfer to the vicinity of the triangular points of the Sun-Earth circular restricted three-body problem (CRTBP). In the Sun-Earth CRTBP, a orbital resonance occurs when Earth and spacecraft have periods of revolution that are a simple integer ratio of each other. It is known that a stable resonant orbit offer the long-term stability which is crucial factor for long-duration mission.

In this study, the flow function method is used to find the resonant orbits in CRTBP. The flow function method is a kind of single shooting method and can find periodic orbits using the characteristic of the periodic orbit which have x-z plane symmetry. A remarkable feature of this method is its graphical representation of periodic solutions.

In this paper, we extend the flow function method for finding resonant orbits and reveal the relation between flow function, resonance and stability of them. First, the resonant orbits in CRTBP are sought using flow function and then the result of finding multiple resonant orbits in the Sun-Earth CRTBP are shown. The result show that the resonant orbits can be found globally and systematically by the flow function method. Moreover, we show that the flow function has information on stability of resonant orbits. Finally, we propose a transfer trajectory to L_5 by using multiple resonant orbits. We also design orbits that can be used to make a tour to the L_4 and L_5.