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Author: Mr. Hongwei YANG
Tsinghua University, China

Mr. Wang Xianyu
School of Aerospace, Tsinghua University, Beijing, China
Dr. Hexi Baoyin
Tsinghua University, China

DELTA-V ASSISTED HOMOCLINIC AND HETEROCLINIC CONNECTIONS OF PERIODIC ORBITS AROUND NATURAL EQUILIBRIUM POINTS OF IRREGULAR ASTEROIDS

Abstract

A new method for designing homoclinic and heteroclinic connections of periodic orbits around natural equilibrium points of rotating Irregular Asteroids is proposed in this paper. Homoclinic and heteroclinic connections can be used for asteroid observing and transfer between equilibrium points. However, challenges arise for the design of Homoclinic and heteroclinic connections because the gravity of an irregular asteroid is not symmetric and the equilibrium points are not exactly located in the equatorial plane. Therefore, design methods for symmetric system cannot be applied directly. Moreover, the Jacobi constants of periodic orbits around different equilibrium points may be different such that active control is required for the heteroclinic connection. In this paper, velocity impulses are used for obtaining homoclinic and heteroclinic connections. Our method for deriving delta-V has the following steps. First, the position and velocity components in the z direction are neglected. Second, a searching method is conducted for matching the position while minimizing the velocity difference using the projections of the stable and unstable manifolds on the defined Poincaré section. Third, the obtained two trajectories are taken as reference trajectories and a differential correction method is used to obtain the delta-Vs at the start of the unstable manifold and the end of the stable manifold for eliminating the position difference in z direction. Last, the delta-V on the Poincaré section is obtained as the velocity difference of the stable and unstable manifolds. The proposed method is applied for asteroids 101955 Bennu and 216 Kleopatra. Numerical results show both delta-V assisted homoclinic and heteroclinic connections are found for these two asteroids.