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THE PERIODIC ORBITS AND STABILITY ANALYSIS OF BINARY BODY SYSTEM FOR ASTEROID EXPLORATION MISSION

Abstract

Mission to asteroids attracts many scientists' interests, since asteroids hold the significant information about the origin of the solar system and the formation of the planets, and also may present a significant hazard to human civilization. According to observation, nearly 2%asteroids belong to binary asteroid system; higher proportion exists in trans-Neptunian objects (TNO), which shows particular scientific value for exploration to binary asteroid system. While the research to periodic orbits and stability analysis of binary body system implies significant meaning for future exploration.

In this paper, the distribution of equilibria, the periodic orbits and their stabilities are discussed in the binary body system, which consists of one sphere and one ellipsoid. Firstly, the model of binary bodies system is built. The densities of sphere and ellipsoid, the centre distance as well as the length of three axes of ellipsoid are set as variables, in order to comprehensively analyze the mechanism of system. The dynamic equation in synodic reference frame is established. Secondly, the equilibria in system are calculated and their stabilities are determined. The influence of density ratio, center distance and shape-change on the distribution and stability of equilibria is investigated. Finally, the periodic orbits around equilibria are computed by differential correction method and their stabilities are determined based on Monodromy matrix.

Different types of orbit families are found in binary body system, which can provide reference to future mission orbit design. At last, the research and analysis in this paper are used to design the orbit for binary asteroid 90 Antiope as an example.