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Author: Mr. Chao Peng
Chinese Academy of Sciences, China

THE HOMOCLINIC AND HETEROCLINIC CONNECTIONS OF PLANAR SYMMETRIC RESONANT ORBITS IN THE RESTRICTED THREE-BODY EARTH-MOON SYSTEM

Abstract

This study presents planar symmetric resonant orbits in the restricted three-body Earth-Moon system and their homoclinic and heteroclinic connections in the vicinity of the Moon are analyzed in details. In the rotating coordinate frame of the circular restricted three-body problem, there exist planar periodic orbits that appear symmetric about the line connecting the Earth and the Moon. The orbital periods of these orbits demonstrate approximately p:q resonance with respect to the Moon (a spacecraft completes p orbits while the Moon completes q orbits around the Earth in the same time interval). For a specified resonant ratio, four cases of these symmetric resonant orbits (those with resonant ratios of 1:1, 1:2, 1:3, 2:1, 2:3, 3:1, 3:2, 3:4 are presented as examples) are defined and computed in the restricted three-body Earth-Moon system. We focus our attention on those resonant orbits that pass through the vicinity of the Moon and compute the corresponding stable and unstable invariant manifolds. Poincare maps are plotted by observing the orbital states of resonant orbits at perilunes and we then identify the presence of the homoclinic connection and the heteroclinic connection. This characteristic of orbital transfers might provide a means for observing the Moon's low-latitude regions with different longitudes and the insertion into lunar orbit is not necessary. Besides, other potential utilizations of the homoclinic and heteroclinic connections for fully making use of lunar gravity assist are also discussed.