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CONSTRUCTION OF QUASI-PERIODIC ORBITS IN ASYNCHRONOUS BINARY ASTEROID SYSTEMS

Abstract

Binary asteroid systems widely exist in the Near-Earth Asteroid population and become potential targets for future exploration missions. According to observations, the asynchronous binary systems are in the majority of binary asteroids systems. The non-autonomous characteristic of asynchronous system makes the dynamics of spacecraft in the system complicated and time-invariant, which makes challenge for the mission orbit design. It is of interest to investigate the dynamics of spacecraft in the vicinity of such systems. In this paper, a method to construct quasi-periodic orbits in asynchronous system is developed and the motional behavior in asynchronous binary asteroid system considering model error and measurement uncertainty is investigated. Firstly, on the basis of the restricted full three-body problem, the motion of spacecraft is established under ellipsoid-ellipsoid systems. By grid search, the periodic orbits in equivalent synchronous system are obtained as initial values. Then, orbits are divided into several segments and integrated in asynchronous system. Two level differential correction process is employed to ensure the continuity of orbits in asynchronous system. Several quasi-periodic orbits are found and their stability are analyzed. Finally, account for the uncertainty of model, the influence of initial angles and spin rate of primaries on quasi-periodic orbits are analyzed. The stability and evolution of quasi-periodic orbits are discussed. The result shows that quasi-periodic orbits are exist in asynchronous binary asteroid system with arbitrary spin rates. This study extends the research of orbital dynamics in binary asteroid system and will provide reference for mission orbit design for asynchronous binary asteroid exploration.