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CALLISTO-GANYMEDE-EUROPA TRIPLE-CYCLER TRAJECTORIES USING THE NEAR-RESONANCES

Abstract

Multiple Jovian moon flybys are preferred for exploration in the Jupiter system. Moon-cycler is a special sequence which can be used to design the tour trajectories. Due to the Laplace resonance, triple-cyclers for flybys of Io, Europa and Ganymede have been founded in previous studies. However, because of the flyby of Io, the cycler trajectories always have low perijoves. The spacecraft in these orbits will bear a lot of Jupiter radiation, which would hazard the electronic devices in spacecraft. Triple-cycler trajectories with Callisto- Ganymede-Europa are a good choice to have a high perijove. However, Callisto is not an exact resonance with the three other moons, so the encounters of Callisto occur aperiodically. Therefore, this paper proposes a method to design Callisto-Ganymede-Europa triple-cycler trajectories. First, the moons are modeled to have circular, coplanar orbits without the ephemerides of Jovian moons. We analyze the near-resonances of Callisto relative to Ganymede and Europa via the synodic periods. Second, we employ the near-resonances to design triple-cycler orbits with different periods with the patched conic model. The designed cyclers are expected to be used in missions with diverse duration and flyby times. Last, the flyby parameters and maneuvers to complete the initial design of the triple-cyclers are optimized. The representative triple-cyclers with relatively lower delta-v are presented.