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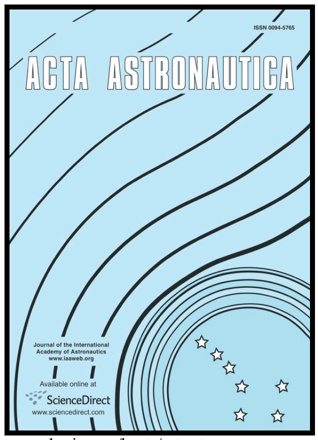

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Halo Orbit to Science Orbit Captures at Planetary Moons

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Abstract

Ballisticly connecting halo orbits to science orbits in the circular-restricted three-body problem is investigated. Two classes of terminal science orbits are considered: low-altitude, tight orbits that are deep in the gravity well of the secondary body, and high-altitude, loose orbits that are strongly perturbed by the gravity of the primary body. General analytic expressions are developed to provide a minimum bound on impulse cost in both the circular restricted and the Hill's approximations. The equations are applied to a broad range of planetary moons, providing a mission design reference. Systematic grid search methods are developed to numerically find feasible transfers from halo orbits at Europa, confirming the analytical lower bound formulas. The two-impulse capture options in the case of Europa reveal a diverse set of potential solutions. Tight captures result in maneuver costs of 425-550 m/s while loose captures are found with costs as low as 30 m/s. The terminal orbits are verified to avoid escape or impact for at least 45 days.

1. Introduction

The recent increased interest in exploration of the outer planets has led to several studies examining missions to the Jovian and Saturnian systems. To maximize the science gain, observation of multiple moons is desired. One option to achieve this goal is a single orbiter that targets multiple moons. A primary enabler of this approach is the ability to efficiently transfer between moons using low-energy

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