Incorporation of trajectory behaviors in the vicinities of different planetary moons using Finite-Time Lyapunov Exponent Maps

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There is an increasing interest in future space missions devoted to the exploration of key moons in the Solar system. These many different missions may involve libration point orbits as well as trajectories that satisfy different endgames in the vicinities of the moons. To this end, an efficient design strategy to produce low-energy transfers between the vicinities of adjacent moons of a planetary system is introduced that leverages the dynamics in these multi-body systems. Such a design strategy is denoted as the moon-to-moon analytical transfer (MMAT) method. It consists of a general methodology for transfer design between the vicinities of the moons in any given system within the context of the circular restricted three-body problem, useful regardless of the orbital planes in which the moons reside. A simplified model enables analytical constraints to efficiently determine the feasibility of a transfer between two different moons moving in the vicinity of a common planet. Additionally, Finite-Time Lyapunov Exponent (FTLE) maps within the context of the MMAT scheme are incorporated to enable direct transfers between moons that offer a wide variety of trajectory patterns and endgames, such as temporary captures, transits, takeoffs and landings. The resulting technique is demonstrated to be applicable to several mission scenarios.

KEYWORDS: Multi-Body Dynamics, Circular Restricted Three-Body Problem, Trajectory Design, Moon-Tour Design, Dynamical Systems Theory, Galilean Moons

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