Paper ID: 88242
student

IAF ASTRODYNAMICS SYMPOSIUM (C1)
Interactive Presentations - IAF ASTRODYNAMICS SYMPOSIUM (IP)

Author: Mr. Suryansh Aryan
Virginia Tech, United States

Dr. Riley Fitzgerald
Virginia Tech, United States

RESTRICTED FOUR BODY PROBLEM CHAOTIC ANALYSIS OF PHASE SPACE STRUCTURES FOR NATURAL MULTI-MOON TRANSFERS

Abstract

Low-energy transfers have an imperative role that makes any interplanetary mission design practically feasible especially for close-encounter observation purposes. Given the large amount of near-future missions planned for all four Galilean moons, we analyze the chaotic dynamics of the Jovian system to build a basic backbone of a sustainable global transport network for the multi-moon missions. The Jupiter-Europa-Ganymede and Jupiter-Ganymede-Callisto Planar Concentric Circular Four Body Problem (PCCFBP) dynamics are implemented to study the periodic perturbation effects on the stable and unstable manifolds of periodic orbits around the L1 and L2 libration points and we explore the ballistic capture design between the secondaries. A Fast Lyapunov Indicator (FLI) map is exploited to study the stability of the PCCFBP hyperbolic manifolds of the libration orbits allowing us to analyse the spectrum of lyapunov exponents in 4D phase space. In the final section, a Stroboscopic map is constructed for the Europa-Ganymede and Ganymede-Callisto regions where the presence of stability islands suggests existence of invariant tori and we discuss in detail the characterization of these orbits. This research work will enable the future use of stochastic control schemes for a low-energy transfer multi-moon mission with increased robustness and performance while taking advantage of sensitivities in the chaotic dynamics of the Jovian system discussed in the paper.