Paper ID: 22928
student

SPACE EXPLORATION SYMPOSIUM (A3)
Moon Exploration – Poster session (2D)

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AUTONOMOUS RENDEZVOUS ARCHITECTURE DESIGN FOR A LUNAR LANDER

Abstract

A precise and convenient targeting architecture for accomplishing the rendezvous of a lunar lander with an orbiter in a near-circular lunar parking orbit is proposed in this paper. This procedure allows for a systematic design and refinement of the number of thrust impulses, their application times, and the mission duration. The simplicity and accuracy of this targeting procedure makes it well-suited for onboard use during real-time control and strategy reconstruction operations. A concise and revealing form of the linearized rendezvous equations are derived based on the Clohessy-Wiltshire model, adopted to generate feasible initial solutions to satisfy the demands of rapid mission analysis and design. A three-step iterative procedure is adopted to determine the minimum-impulse control strategies for autonomous rendezvous, involving progress of the solution from a linear model to a nonlinear, two-body model and finally, to a high-fidelity model. The two-body model is introduced as an intermediary, to enable a smooth transition from the linear to the high-fidelity lunar gravitational model. Numerical simulations are undertaken to verify the control strategies calculated and to illustrate the efficiency and convergence of the proposed iteration algorithm.