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OPTIMAL AUTONOMOUS RENDEZVOUS DESIGN FOR A LUNAR LANDER USING THE J2-PERTURBED STATE TRANSITION MATRIX

Abstract

A method for the optimization of a multi-impulse autonomous rendezvous sequence for lunar probe near the Moon is proposed in this paper. The perturbed state transition matrix is adopted to establish the targeting autonomous rendezvous equations under the effect of the J2 perturbation in a near-circular lunar parking orbit. A method for calculating optimal rendezvous control strategies is presented in the perturbed model. In this method optimal control solutions are constructed by satisfying the targeting autonomous rendezvous equations for the lunar mission. The necessary gradients are developed analytically by the linear perturbation theory, and a complete and closed-form expression for computing gradients of a general n-impulse rendezvous maneuvers is also established. The Trust-Region Dogleg Method is used to solve the analytical optimal equations. Numerical results are presented to demonstrate the fidelity and application of this approach.