ASTRODYNAMICS SYMPOSIUM (C1)
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ANALYTIC EXPANSIONS OF LUNI-SOLAR GRAVITY PERTURBATIONS ALONG ROTATING AXES FOR TRAJECTORY OPTIMIZATION: PART2: THE MULTIPLIERS SYSTEM AND SIMULATIONS

Abstract

An efficient self-contained trajectory optimization software is generated by making use of de Pontécoulant's analytic lunar theory removing the need for an outside third body ephemeris program to compute the lunar and solar position vectors at each integration step. The accelerations being further resolved along the rotating Euler-Hill frame after expansion to third order in the spacecraft radial distance, the adjoint differential equations are derived in a direct manner complementing the generation of the dynamic system of equations for full compatibility. Because the variation of parameters equations are cast in terms of the nonsingular equinoctial elements with the perturbation accelerations resolved in their analytic form along the rotating axes, the adjoint equations are also derived in the same manner providing a highly efficient and accurate system of equations for rapid computations in conjunction with The Aerospace Corporation's NLP2 nonlinear programming codes to search for the initial values of the multipliers that steer the spacecraft towards its target orbit in minimum time. Numerical simulations show that the solutions obtained by the analysis developed in this paper are essentially identical to the more indirect approach based on the use of inertial accelerations obtained from a separate ephemeris generator and subsequent conversions to the thrust frame and equinoctial system.