

ASTRODYNAMICS SYMPOSIUM (C1)
Optimization (1)

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OPTIMAL EARTH-TO-MOON TRAJECTORIES WITH COMBINED IMPULSE/LOW THRUSTERS

Abstract

In this paper, optimal Earth-to-Moon trajectories are presented with a combined impulse type thruster and VSI low thruster. Three-body dynamics is considered, but the other perturbed force is not considered for the analysis of baseline trajectories. In the Earth escape phase, the transfer time is a critical factor due to the Van Allen radiation belt. So, an impulsive type thruster is used in the Earth escape phase with a shorter transfer time rather than that of moon capture phase. Trans-lunar phase is a kind of coast arc where any thrust is not used. In the lunar capture phase, low thrust of VSI type engine is used for the mission. The capture trajectories are consisted of many spiral trajectories. Trajectories type of long transfer time and multi-revolutions, are difficult to design optimal trajectories with indirect method due to the convergence radius. So, in this paper, initial guess method is presented which developed in the preliminary researches. Direct/Indirect multiple shooting method is adopted to patched the two optimal trajectories. The contribution of this paper is to suggest the cost function which is related to minimize fuel consumption for the combined engine problem, to analysis of Moon capture phase and to introduce the design procedure. Numerical examples of the optimal trajectories can be shown in this paper with under the 20 days transfer time (5-day : Earth-escape phase + trans-lunar phase, under 15-day : lunar-capture phase)