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OPTIMUM LOW-THRUST POWER TRANSFER AND RENDEZVOUS BETWEEN ARBITRARY NEIGHBORING ORBITS IN THE PRESENCE OF J2 PERTURBATION

Abstract

[Abstract] An analytic solution for optimum low-thrust power transfer and rendezvous between neighboring elliptic non-coplanrity orbits is prensented in this paper that was obtained by considering perturbation at the same time. This analytic solution is deduced from an optimization problem by applying optimal control theory and the pontryagin maximum principle. The optimization problem is formulated as a Lagrange problem of optimal control which use the six orbital elements of elliptic orbit as state variables. To simplify the problem, the coefficient for the second zonal harmonic J2 and the nondimensional thrust acceleration are supposed to be the same order of magnitude. After applying optimal control theory and the pontryagin maximum principle, the integrate equation are divided into three parts of the undisturbed part, the part due to thrust acceleration and the part due to the second zonal harmonic. The previous two parts are integrated with eccentric anomaly as independent variable; the last part can get its first-order analytical solution by mean element method. The solution equations are linear when both the six orbital elements and the corresponding adjoint variables changed. And then some simple analytic solutions for long time transfer are obtained explicitly by neglecting short-period perturbations. Finally a series of typical examples are given to show that the solution obtained in this paper is enough accurate for the thrust acceleration A whose magnitude is between and . And the solution has been found to produce fairly agreement with the results obtained by Fernandes in 1989. This analytic solution is expected to benefit power transfer and rendezvous where a large number of computational simulations have to be performed.