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Author: Ms. Elisabetta Iorfida
Surrey Space Centre, University of Surrey, United Kingdom, e.iorfida@surrey.ac.uk

Dr. Phil Palmer
Surrey Space Centre, University of Surrey, United Kingdom, P.Palmer@surrey.ac.uk
Prof. Mark Roberts
University of Surrey, United Kingdom, m.roberts@surrey.ac.uk

OPTIMISATION MODELLING OF MID-COURSE CORRECTIONS ALONG INTERPLANETARY TRANSFERS

Abstract

The primer vector theory, firstly proposed by Lawden, defines a set of necessary conditions to characterise whether a transfer trajectory is optimum with respect to propellant usage, within a two-body problem context. If the conditions are not satisfied, one or more potential intermediate impulses are performed along the transfer trajectory, in order to lower the overall cost. The method is based on the propagation of the state transition matrix and on the solution of a boundary value problem, which leads to a mathematical and computational complexity.

A novel propagator has been developed and it is based on the decoupling between the in-plane and out-of-plane components of the primer vector on the orbital plane. It reduces the mathematical complexity and the computational cost of the problem presented by Lawden. This paper shows a case that exploits the properties of the novel propagator. The optimality has been analysed keeping the transfer arc fixed, while the departure and arrival trajectories are varying. The search space is defined by the direction of the thrust impulses together with the eccentricity and semi-major axis of the transfer orbit. Within an extensive analysis, the "optimality maps" have been obtained, which show how the variables of the problem can be related to the addition of the mid-course corrections.