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SMALL SATELLITE MISSIONS SYMPOSIUM (B4)
Hitchhiking to the Moon (8)

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TRAJECTORY OPTIMISATION OF A VERY-LOW-THRUST LUNAR MISSION SUBJECT TO HIGHLY NON-LINEAR THRUST CONSTRAINTS

Abstract

This paper presents the status of trajectory optimisation for the all-electric satellite *Lunar Mission BW1*, proposed by the Institute for Space Systems (IRS) at the University of Stuttgart. Mission constraints and design compromises have imposed many severe non-linearities on the thrust profile. For example, reaction wheel desaturation and groundstation access limit the times available for thrusting, while limited battery capacity constrains the thrust duration before an idle period for recharging is needed. Furthermore, the long transit time resulting from using an electric propulsion system magnifies the effects of small perturbing forces acting on the spacecraft which are usually neglected in other trajectory studies.

To overcome these difficulties a non-linear programming approach was utilised, exploiting state-of-the-art optimal control software developed by Boeing. The flight dynamics, cost function, path and boundary constraints were carefully modelled such that they appear as linear parameters to the optimisation interface, allowing the independent and combined effects of each constraint to be investigated. Preliminary results of this optimisation are presented, with a discussion of sensitivity analysis to ensure robustness in the event of subsystem failure or off-nominal conditions.