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SPACE EXPLORATION SYMPOSIUM (A3)
Moon Exploration – Part 1 (2A)

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NAVIGATION AND CONTINGENCY ANALYSIS OF THE EUROPEAN STUDENT MOON ORBITER

Abstract

The European Student Moon Orbiter (ESMO) is the first lunar mission, supported by the European Space Agency (ESA), entirely designed by students , and currently the only planned ESA mission to the Moon in the near future. The launch is scheduled for the year 2014-2015 as a piggy-back payload of a commercial launch in GTO. ESMO has no freedom of choosing the launch date and time and has a significantly low upper limit on the total delta-V. In order to accommodate the constraints on the launch and total delta-V, an every-day trans-lunar WSB transfer trajectory had to be designed to exploit every potential launch opportunity. However, the flexibility and gain in delta-V came at the expenses of a higher sensitivity to the initial conditions and transfer manoeuvres. In addition, the very low cost imposes a limit on the qualification of a number of components, which translates into an increased uncertainty of the overall mission. All these aspects required the definition of a particular navigation strategy that could guarantee capture even under significant levels of uncertainty. The navigation strategy maintains the spacecraft within a so-called capture corridor that would allow a satisfactory orbit insertion at the Moon and an acceptable variation of the lunar orbit. This paper presents a navigation and contingency analysis for the WSB transfer of ESMO. Both uncertainty in the orbit determination process and in the control of the thrust vector are included in the navigation analysis. Furthermore, the occurrence of possible contingencies, such as the misfire of an engine, the delay in the execution of a manoeuvre or the underperformance of the propulsion system, is included in the simulation model. In will be shown that some manoeuvres can be delayed by several days while other have a high sensitivity and need to be performed on time. Optimal recovery options are designed by replanning the part of the trajectory subject to contingency. Trajectory Correction Manoeuvres are optimally allocation in order to reinsert the spacecraft within the capture corridor. Analyses are presented for different transfer scenarios and final target lunar orbit.