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ORBIT DETERMINATION AND CONTROL FOR THE EUROPEAN STUDENT MOON ORBITER

Abstract

Scheduled for launch in 2013-14, the European Student Moon Orbiter (ESMO) will be the first lunar microsatellite designed entirely by the student population. Using chemical propulsion, ESMO is devised to reach and enter a polar orbit, with a primary mission objective to acquire surface images of the South Pole. High resolution data gained over a six month period with a maximum periselenium attitude of 200 km, will be achieved. This is gained through a Narrow Angle CCD Camera (NAC). To complement the scientific return, a 3 kg Biological Lunar Experiment (BioLex) is intended to investigate the effects of the space environment on simple biological organisms.

The final polar orbit will be achieved through use of a Weak Stability Boundary (WSB) transfer. This is coupled with an all-day piggyback payload launch opportunity. Currently ESMO has little or no control over the launch date. A WSB transfer therefore has the additional benefit of offering a higher degree of flexibility in the final selection of the launch vehicle and associated reduction in delta-V. However, this benefit, due to the sensitivity dynamics in the navigation error, must be considered against having to use a far more complicated navigation strategy. The WSB transfer trajectory must therefore utilise mitigation approaches and correction strategies.

This paper will present the orbit determination analysis of ESMO and an optimal orbit control strategy to ensure capture at the Moon. ESMO will be injected into a highly elliptical lunar orbit at the end of the WSB transfer. The interval of orbital elements that satisfies the mission requirements defines the injection corridor. The orbit control strategy plans and schedules a set of Trajectory Correction Manoeuvres, along the transfer, in order to target the corridor at a minimumal delta-V cost. The paper will present results for different launch conditions, target orbits and available ground stations for the orbit determination process.