ASTRODYNAMICS SYMPOSIUM (C1)
Mission and Constellation Design (5)

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JUPITER GANYMADE ORBITER: DESIGN OF THE PSEUDO-ORBIT NEAR CALLISTO

Abstract

ESA and NASA have recently decided to jointly pursue a mission to study Jupiter and its four largest moons, Io, Europa, Ganymade and Callisto. Two S/C will be build, the Jupiter Ganymade orbiter (JGO) by ESA, which will focus on Ganymade and Callisto, and the Jupiter Europa orbiter (JEO) by NASA, which will focus on Europa and IO. Launch by two separate launchers is scheduled in 2020 with arrival at Jupiter in 2026. The ESA provided JGO will be injected into a 200 x 6000 km polar orbit around the prime scientific target Ganymade and later on be transferred to a 200 km circular orbit. To reach this orbit with the available fuel, a 1 year long complex tour is needed in the Jupiter system involving gravity assists at Callisto and Ganymade. Orbits significantly below Ganymade must be avoided to limit the radiation dose incurred by the S/C. Another objective of the JGO is to study Callisto on its way to Ganymade. Ideally, this is done from a moon centred orbit. However, capture at and subsequent departure from Callisto is not possible with the available fuel. A pseudo-orbit solution has been proposed and retained, which avoids capture and nevertheless provides reasonable science observation opportunities. Its design will be presented in the paper.

The objective is to get a reasonable number of low-altitude and geographically well distributed fly-over's in a possibly short time period. The strategy consists of a sequence of gravity assist fly-by's at and resonant orbits of various inclinations with Callisto. Near a V-infinity of 2 km/s it is possible to alternate between 1/1 (moon rev / S/C rev) and 2/1 resonances providing left and right lateral fly-over's at 200 km altitude and 30 deg away from the meridian plane containing Jupiter (note that Callisto is in lock with Jupiter). Alternating between 1/1 and 2/3 resonances, results in lateral coverage 60 deg away from that meridian. The meridian itself is covered by a sequence of 1/1 resonances. Resonances with low peri-jove (e.g. 2/3) are excluded because of radiation. Combining these 3 sequences provides around 20 geographically well distributed fly-over's at 200 km altitude within somewhat more than 1 year and involving a deterministic Delta-V of 140 m/s.