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NUMERICAL STUDY ON LOW COST CONNECTIONS BETWEEN THE SUN-EARTH LIBRATION POINT 2 AND THE EARTH-MOON LIBRATION POINT 2 REGIONS FOR SATELLITE SERVICING

Abstract

The Sun-Earth Libration Point 2 (SEL 2) located about 1.5 Million km from Earth is a preferred location for new generations of large space telescopes. Eclipse free orbits guarantee a constant power generation and provide for a thermally stable environment, avoiding stress on the spacecraft and thus perturbed measurements of the sensor payload. Additionally the alignment of the Sun, Earth and Moon allows for observations of half of the sky at any time.

From an energetic point of view the SEL 2 is close to the Earth-Moon Libration Point 2 (EML2). This fact should allow for transfers between both regions with little to no ΔV and indeed those transfers could be shown for special types of orbits by [Lo, Howell, Canalias, Masdemont]. These transfers could enable for satellite servicing, which might be especially beneficial for large observatories with a long life-cycle, due to the possibility to update outdated sensor hardware and reuse the expensive mirrors. The example of the Hubble space telescope shows, how a mission could be successfully repaired, maintained and updated by facilitating crewed servicing. While a crewed mission to the SEL seems unrealistic due to the either long transfer time or large ΔV requirements, the servicing could take place in the vicinity of the Earth, at the EML 2 point.

In this study the return trajectories from SEL 2 orbits reachable via a free-transfer from an Ariane5 ECA launcher to fixed orbits about the EML 2 were investigated. These transfers accounted for the rendezvous constraint at the EML 2, where crewed servicing hardware was assumed to be present. Five different types of connecting trajectories were identified between the SEL2 and EML2 regions, however, only two of these options seemed promising due to regular occurrence. These are the options utilizing an Earth fly-by and the Weak Stability Boundary (WSB) region.

The numerical methods for identifying the transfer options will be discussed. To demonstrate the method, different Ariane5 ECA SEL 2 reachable orbits were calculated for every launch date over a two year period. Low cost return opportunities for the first three years of the SEL2 orbit phase via the two options were identified and calculated. These results allowed deriving constraints on the SEL 2 orbit amplitudes in order to be connected to the fixed EML2 orbit.