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TOUR DESIGN TECHNIQUES FOR THE EUROPA CLIPPER MISSION

Abstract

Europa is one of the most scientifically interesting targets of the solar system, as it may possess the three necessary ingredients for life: an extensive ocean of liquid water, an energy source from tidal heating, and a suite of biogenic elements. To explore the habitability of Europa, NASA is developing the Europa Clipper mission, currently scheduled to be launched in 2022.

Europa resides deep inside the gravity well of Jupiter, in a region of the magnetosphere with many trapped ionized particles that get accelerated to near relativistic speeds; a Europa orbiter mission would require a large amount of V for an orbit insertion maneuver, and would only return limited science data before being critically exposed to radiation. To mitigate these issues, Europa Clipper instead only utilizes Europa flybys, connected by Europa-resonant and non-resonant orbits. Science data is collected during high-radiation passes, and returned to Earth during the rest of the Jovian orbits, at a much lower radiation dose exposure.

This paper will present several tour tools techniques developed for the design of the Europa Clipper flyby trajectory. In particular, the paper will describe different ways to perform fast line-of-apsides rotations; a new approach to improve the coverage of Europa's trailing and leading edges, with the lighting conditions considerations; parametric studies of the expected radiation dose and time-of-flight as function of the Europa resonance; groundtrack distributions for mixed pumping-cranking sequences; and a quick way to estimate the radiation dose for Jovian tours. Other techniques, that were already presented in previous papers, will be reviewed for completeness. We then implement some of the new approaches in the 18F14 tour.