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Author: Mr. James Torla
Arizona State University, United States

Prof. Matthew Peet
Arizona State University, United States

OPTIMIZATION OF LOW FUEL AND TIME-CRITICAL INTERPLANETARY TRANSFERS USING SPACE ELEVATOR APEX ANCHOR RELEASE: MARS, JUPITER AND SATURN.

Abstract

In this talk, we examine the potential impact of a Space Elevator Apex Anchor for permanent human habitation of Mars and the Moons of Jupiter and Saturn. Apex anchor release trajectories refer to the low-cost interplanetary insertions corresponding to the initial velocity vector achieved at the apex of any higher-than-geosynch space elevator. The velocities of these apex anchors in most cases are beyond earth escape velocities and under certain conditions can yield interplanetary transfers with minimal Delta-v requirements. In this work, we have used iterative methods based on a variation of Lambert's Problem to determine the minimal Delta-v direct transfer from an Apex anchor to Mars, Jupiter and Saturn under a variety of initial conditions and time-of-flight constraints. Permanent human habitation of distant planets requires both cost-effective methods of transportation of a massive amount of materiel and the ability to reduce the time-of-flight for human passengers and safety-critical supplies. Our results demonstrate that the use of an Apex anchor release can address both needs by dramatically reducing the time-of-flight for a fixed Delta-v budget, or, conversely, dramatically reducing the Delta-v budget (and hence costs) when time-of-flight constraints are relaxed.