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DESIGN AND ANALYSIS OF EMERGENCY RETURN ORBITS FOR MANNED EARTH-MOON TRANSPORTATION MISSION

Abstract

In recent years, lunar exploration has been attracting great attention, and several transportation mission concepts from the Earth to the Moon based on the Lunar Orbital Platform-Gateway (LOP-G) have been proposed, such as NASA's Artemis mission and Chinese DRO mission. These libration point orbits are the gateway to the cislunar space and ideal candidate locations for LOP-G. Most abort orbit designs are based on two-body direct transfers, however considering the high sensitivity of three-body dynamics, abort orbits for LOP-G missions can have more possibilities.

This paper focuses on the design and analysis of emergency returns during the manned LOP-G missions in the future. Two emergency return options are considered: direct return and lunar-flyby return. For the lunar-flyby return, this paper proposes a method for patching transit orbits and flyby return orbits. Compared to traditional two-body methods, this method gives new solution spaces for emergency returns. Then, this paper investigates velocity increments and transfer time from various abort points, trajectories with lower cost are discovered for limited transfer time. In addition, the windows for spacecraft emergency return are discussed. Finally, suggestions for returning to Earth or continuing to the LOP-G are given according to different classifications of failures. The results of this research will serve as a valuable reference for the planning and design of future manned missions at LOP-G.