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A REVISED ALGORITHM TO CALCULATION OF CIRCUMLUNAR TRAJECTORIES

Abstract

In near future, China will launch manned lunar mission as the consequent program of Chang'er. As we know, the free-return circumlunar trajectories are the fundament of the manned lunar mission. The hybrid trajectories and mission abort trajectories are designed based on the free-return circumlunar trajectories. Battin had introduced an algorithm of calculation of circumlunar trajectories; LTOC had given a small collection of results. But for the trajectories designers, especially in the mission abortion circumstances, the solution set is necessary for analysis the abortion option. This paper contributes a revised algorithm to calculation of circumlunar trajectories based on the Battin's algorithm. The independent variables have been chosen differently from Battin's, according to searching the possible independent variables, therefore, for a specific manned lunar mission, the solution set of the free-return circumlunar trajectories could be gained. The characteristics of the solution set are analyzed based on a specific manned lunar mission. Considering the moon is running at the ellipse orbit with a small eccentricity around earth, the distance between the earth and the moon varies during a mouth. The characteristics of the solution set are analyzed for the typical longest and nearest earth-moon distance. For the manned lunar mission design, the inject ΔVtotal travel timelanding site selection are the most important parameters. According to the solution set, some significant conclusions have got in this paper. Increasing the inject ΔV, the total travel time decreases incredibly, but when inject ΔV reach a critical point, the total travel time doesn't decrease any more. For a specific inject ΔV, the total travel time varies with the inject position, a slight different between the inject points, the different of the total travel times could be all most 2 days. When the moon is at the perigee, the total travel time will much less than moon at the apogee. The best inject position varies with the antipole of the moon. The entry points circle around the antipole of the moon in the earth centered celestial sphere coordination. All these phenomena are important for the trajectory designer to define the precise inject window. At last, a typical free-return trajectory is selected for the manned lunar mission based on the constraints of China's requirements. The results gained here can shed light on the future manned lunar mission trajectories design.