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POLYNOMIAL GUIDANCE LAW VERSUS THE GRAVITY TURN GUIDANCE LAW FOR LUNAR ASCENT

Abstract

With the success of several orbiting missions to the moon in the last few years, robotic-landing and sample-return missions are now on the agenda of several space agencies. And according to the long-term plan of the China lunar exploration programme, a sample-return mission will be launched around the year 2017. For the lunar sample-return mission, the guidance law for lunar ascent has always been one of the key points in achieving a successful ascent from the lunar surface. In this paper, the polynomial guidance law and the gravity-turn guidance law for lunar ascent are studied. In line with the former Apollo mission, lunar ascent can be divided into three subphases, i.e., the vertical ascent phase, the single-axis rotation maneuver and the orbit-insertion phase. The aforementioned guidance law will be implemented in the orbit-insertion phase. For study purposes, however, these two guidance laws are examined on the complete lunar ascent phase. The main emphasis of this paper is put on analyzing advantages and disadvantages of these two guidance laws in various aspects, i.e., fuel consumption, robustness with respect to change of initial conditions at the beginning of the orbit-insertion phase and final conditions at the orbit-insertion point, etc, and also their scope of application. It is assumed that the out-of-plane motion and the in-plane motion are uncoupled, and that the out-of-plane motion can be independently controlled. Therefore, only 2-D trajectories are examined. It is expected that the outcome of this study will be beneficial to guidance-law design for future lunar sample return missions.