Lunar Exploration (3)
Lunar Analysis & Simulation (4)

Author: Ms. Chen Haiping
National University of Defense Technology, China

ANALYSIS AND OPTIMUM DESIGN FOR EMERGENCY ESCAPE TRAJECTORY IN MANNED LUNAR LANDING MISSION

Abstract

Since the beginning of the 21st century, the second tide of lunar mission has swept the world. Manned lunar missions are put on the agenda of the developed countries. The domestic research of manned lunar mission project has just been started up. In manned lunar mission, unforeseen circumstances can induce emergency situations necessitating contingency plans to ensure crew safety, for example, the damage to spaceship, the injury to astronauts, etc. These miserable situations make the landing lunar mission impossible. Back up parts for the spaceship and medicine care for the astronauts are necessary to ensure the mission carry on. But in the emergency situation, mission has to be abort, so that the spaceship can bring back the astronauts. For safety's sake, circumlunar free return trajectory and hybrid trajectory are preferred in manned lunar mission. The abort trajectory is based on the specific mission trajectory. Designing an emergency escape trajectory is very important, from which astronauts can be carried return to Earth. This paper investigates the emergency escape trajectory optimum design problem, which using finite maneuver to abort the manned lunar landing mission. The analytical model of the emergency escape trajectory is derived. The probability and the fuel consumption or the flight time cost are analyzed when accident at different phase of the mission, including near earth abort trajectory and near moon abort trajectory. Then the mission trajectory optimization model is established considering the high degree of accuracy perturbations. The save energy and flight time together trade-off optimum emergency escape trajectory satisfying the special constrains is designed using Gauss pseudospectral method. Numerical simulations are then presented to show the correctness and effectiveness of the model developed.