SPACE EXPLORATION SYMPOSIUM (A3)
Moon Exploration – Part 3 (2C)

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TRAJECTORY DESIGN OF CUBESAT IMPACTOR FOR LUNAR SCIENCE MISSION

Abstract

The cubesat as a lunar impactor can be used to perform the lunar surface science mission including lunar magnetic field measurement. To achieve the near-surface measurements of specified impact site, the impact trajectory design is important. The cubesat is released by a mother lunar orbiter from the lunar orbit to designed impact trajectory, and then it impacts on the desired lunar surface.

The Polytechnic State University and Stanford University developed the Cubesat, which is a miniaturized satellite, to perform space science and exploration in 1999. After that, the cubesat is widely used in many space missions by many universities, research centers, and companies, because it has various advantages such as low cost and flexibility. Moreover, the cubesat can be usually secondary payload on large missions, and the cubesat is deployed into desired orbit after the primary payload has been performed. As a result, the cubesat has been considered to achieve the planetary science mission as well as the Earth science mission.

In this study, the cubesat is used as a lunar impactor to perform the lunar science mission. For accurate science measurement, the impact trajectory from the lunar orbit to the specified impact site should be designed. The conceptual design of this mission is as follows: a lunar orbiter with a cubesat is launched and flies to the moon through the trans-lunar trajectory. Near the lunar trajectory, the lunar orbit insertion (LOI) is performed to capture the desired lunar orbit. On the lunar orbit, the lunar orbiter performs the commissioning to check and calibrate the spacecraft system, and then releases the cubesat impactor using deorbit burn. Then the cubesat is maneuvered into the designed impact trajectory to the lunar surface, while the attitude stabilization is performed using its own propulsion system. The impact trajectory is designed using the Hohmman transfer or the Lambert's theorem. When the cubesat is deployed at the apoapsis of the lunar orbit, the Hohman transfer can be considered to generate the trajectory. On the other hand, the impact trajectory can be designed using the Lambert's theorem, when the cubesat is released at the specified position of the lunar orbit.

At the final manuscript, the cubesat impact trajectories will be derived according to the released point, and the numerical simulation results will be shown to verify the designed trajectory.