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Moon Exploration – Part 1 (2A)

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CUBESAT MOON LANDER OMOTENASHI: ITS DEVELOPMENT AND IN-ORBIT OPERATION

Abstract

OMOTENASHI (Outstanding MOon exploration TEchnologies demonstrated by NAno Semi-Hard Impactor) will be the world's smallest moon lander. It will be launched by NASA's Space Launch System (SLS) Artemis-1 with Orion spaceship in 2022. The mission objectives of OMOTENASHI are (1) demonstration of nano-lander technology and (2) observation of radiation environment in Cis-lunar region. To realize the moon lander within 6U CubeSat size, some new technologies have to be developed. In this presentation, mission outline, spacecraft design, development results, and in-orbit operation of OMOTENASHI are shown. If Artemis-1 has been launched before the conference, mission results will be also presented.

The spacecraft consists of three parts, Orbiting Module (OM), Rocket Motor (RM), and Surface Probe (SP), because the separation in orbit is essential to reduce deceleration mass for landing. To decelerate the orbital velocity from 2500 m/s, a small solid rocket motor is employed. By the ignition of the RM, RM+SP will be separated from the OM. Since the deceleration is conducted by the solid rocket motor, roughly 50 m/s velocity error at the impact on the moon surface will remain. To withstand the high-speed impact, a crushable material which is sandwiched between the SP and the RM, will be used. It will reduce the impact acceleration within 10,000 G. Epoxy filling of the instrument box of the SP will cope with the impact shock.

Due to the size limitation of the onboard hardware, we have developed some onboard and on ground software. And we have considered the operation plan. For example, we installed onboard autonomous orbital maneuver sequence which meets power constraints. And to minimize impact velocity to the moon surface, an optimum trajectory has been designed.

We have already completed the spacecraft and handed over it to NASA in July 2020. We are currently conducting operational rehearsals using a spacecraft simulator.