SPACE EXPLORATION SYMPOSIUM (A3)
Small Bodies Missions and Technologies (4)

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ASTEROID SURFACE EXPLORATION ROVERS DEVELOPED FOR HAYABUSA-2 MISSION

Abstract

1 Introduction

The authors have installed a rover package named "MINERVA-II" to the asteroid sample return mission "Hayabusa-2", which was launched on 3 December 2014 heading for the C-type Near Earth asteroid 1999JU3.

The package consists of two rover containers, a relay module and an antenna to communicate with the rovers. Three rovers are included in the two containers. Two of them installed together in one container are the responsibilities of the authors. Another one in the secondary container came from the domestic university members.

All the rovers were developed without the official budget from the mission to seek for the technology-driven challenges on the surface of the target asteroid.

This paper summarizes the capabilities of the two rovers developed by the authors.

2 Asteroid surface exploration

Two rovers are almost identical except the thermal parameters of the body with a mass of approximately 1.1[kg].

They are ejected when the spacecraft descends to the surface after the arrival at the asteroid. They fall into the asteroid surface by the weak gravity and then start an autonomous exploration when the obtained data are transmitted to the relay module on the mother spacecraft. They have a hopping mobile system fitted for the microgravity environment of the asteroid surface.

3 Rover capabilities

Technical experiments on the evaluation of the hopping mobile system and demonstration of the fully autonomous exploration are the main purposes of the rovers. But we do not forget about the scientific characterization of the asteroid. We have installed tiny sensors into the rovers: two types of cameras, thermometers, potentiometers, accelerometer, gyro, and photodiodes. Some of them are processed onboard for the autonomous navigation, the others are purely used for scientific observation.

The wide angle camera with a mass of 15[g] will take the asteroid surface from a distance when the rover is hopping. It has a field of view of 125[deg] with a combination of eight tiny lenses. You can get a nearly perfect perspective view with this camera since the distortion is less than 3[%] for all the region.

When the rover stays on the surface, the measurements by thermometers and potentiometers are made, as well as the terrain shooting by the another cameras. The stereo pair of normal cameras is optimized to acquire the precise terrain features. Thermometers can directly measure the temperature at the contact point on the surface. Potentiometers can obtain the potential differences between the two contact points.