

Development of mobile sensor for volcanic observation “HOMURA” : operation at Kirishima Iwo-yama and test for a long-term operation at Kyoto University

*Katsuya Kaneko¹, Kodai Iwahori², Koichi Ito², Hirotarō Sagi³

1. Graduate School of Science, Kobe University, 2. Graduate School of Science, Kyoto University, 3. Integrated Human Studies, Kyoto University

Monitoring of phenomena near craters of active volcanoes is important to learn symptoms of volcanic eruptions and to understand eruption dynamics. At present, some devices such as crater camera, volcanic gas sensors, and seismographs have been installed in calm periods of volcanic activity. On the other hand, there are some cases where we cannot install new monitoring devices at volcanoes without enough devices after volcanic eruptions occur. In this case, unmanned robots are useful. We are trying to develop a practical unmanned-ground-vehicle-type robot for volcanic observation that carries out monitoring near active craters. We named this system "Homura". In this presentation, we report results of test campaigns for operation of Homura in outdoor fields.

At present, we have developed a prototype of Homura. It is a small-sized, vehicle-type robot with six wheels (750 x 430 x 310 mm in dimensions and a weight of about 12 kg). It is remotely controlled with mobile phone radio waves; it can move in volcanic fields and send real time data of sensors (camera, thermometer, and CO₂ gas sensor for test) equipped in the vehicle to the base station. Power consumption of Homura is about 20 W in an operation state and less than 0.1 W in an idle state, so that we can use Homura for a long time by intermittent operation.

We carried out two test campaigns of Homura at Kirishima Iwo-yama from Feb. 19th, to May 5th (49 days) and from Mar. 3rd to Apr. 14th (37 days). Iwo-yama is one of craters in the Kirishima volcanic field, SW Japan; after 2014 volcanic seismicity sometimes increases around Iwo-yama and there is danger of eruptions. We carried and put Homura at the rim of the crater. Unfortunately, mobile phone connectivity was not entirely stable around Iwo-yama. Then, we decided not to move Homura and only to obtain real time data of the sensors. After we returned to our office, we operated Homura for one to two hours every day. Although the weather was often bad (rain, fog, or cold temperature) during the test campaigns, we could completely operate Homura without any trouble. In order to use Homura for longer period, we installed a small solar panel on Homura. Since Oct. 10th, we have been operating Homura at the roof of a building in Kyoto University. Homura obtain sensor data for 4 minutes every 6 hours. Up to the present (128 days), we can stably operate Homura.

The results of these test campaigns indicate that Homura steadily functions for a long time in volcanic fields. Homura is useful as a simple monitoring station in volcanic fields where mobile phone connection is available.

This work was supported partly by a grant-in-aid for scientific research from the Japan Society for the Promotion of Science and the Earthquake Research Institute cooperative research program.

Keywords: Robot for monitoring volcanoes, Kirishima Iwo-yama, communication with cellular phone

