Development of mobile sensor for volcanic observation “HOMURA”: Test campaigns for a long-term operation

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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 a test of Homura for about one month at Kyoto University in January, 2015. Homura was put on the roof of a building and operated by remote control. Although Homura was exposed to snow and rain during the test, all the functions of Homura (the traveling system and sensors) normally worked.
From Feb. 19th to Apr. 8th, 2015, we carried out a test campaign of Homura at Iwo-yama to examine if Homura can work for a few month in natural volcanic fields. Iwo-yama is one of craters in the Kirishima volcanic field, SW Japan; the area within 1 km from the crater was an off-limit area from Oct. 24th, 2014 to May 5th, 2015 because volcanic seismicity there was active and eruption might occur. On Feb. 19th, 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 until Apr. 8th. Although the weather was often bad (rain, fog, or cold temperature) during the test campaign, we could completely operate Homura without any trouble. On Apr. 8th, the battery in Homura ran down. After we collected Homura from Iwo-yama and recharged the battery, Homura perfectly worked again. The results of this campaign indicate that Homura stably functions for a long time in volcanic field. Homura is useful as simple monitoring station in volcanic fields where mobile phone connection is available.
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