Development of mobile sensor for volcanic observation

Katsuya Kaneko[1]; Koichi Ito[2]; Yuichi Anbe[2]

[1] Human and Environmental Studies, Kyoto Univ.; [2] Science, Kyoto Univ.

Monitoring of volcano near or inside active craters is very important to detect precursors of volcanic eruptions and understandings of eruption dynamics. At present, observations of active volcanoes, for example, by remote-controlled camera and some geophysical monitoring are carrying out. On the other hand, observation inside and at the bottom of active craters of volcanoes whose activities are increasing is very difficult because we cannot work there for danger of eruption and volcanic gas. Recently, 'MOVE' (mobile observatory for volcanic explosion) has been developed. It is a great challenge to monitor volcanic phenomena near active craters. Unfortunately, it cannot go down on steep slope and reach to the bottom of the craters.

The purpose of this study is to develop 'mobile sensor for volcanic observation' (referred to as MSVO, hereafter). The MSVO moves by remote control. It should go down to the bottom of volcanic crater that becomes active more and more and monitor phenomena changing every moment. In this report, we introduce an experimental MSVO. Simply, the MSVO is a radio-controlled vehicle with some sensors for geophysical monitoring that can move on rough surface. Development of MSVO is new trial. Goal at the first step is in the following.

MSVO can move on rough surface covered with gravels and angular stones.
MSVO can climb up and down on slopes with an angle of 30-40 degrees.
MSVO can transfer real-time data of geophysical monitoring.

We built an experimental MSVO. We hope that it has the required performances above. Specifications of mechanical part of the MSVO are in the following.

Material of the body: Aluminum with 2 mm thick.
Size of the body without wheels: 560 length x 230 width x 50 height mm.
Wheel: Motor-driven 6 wood wheels with 310 mm diameter of pentagonal starlike shape
Power: 8 sets of 6-cell 'AA' size nickel-hydrogen battery
Total weight: about 8.5 kg.

There are two good features of the MSVO. First, shape of the MSVO body is vertically symmetric. Then, even if it turns over, it can move normally. Second, the wheels have starlike shape. The MSVO can climb over a step.

Next, specifications of wireless communication and measurement device are in the following.

Communication: 1.2GHz-band, half-duplex, digital communication.
Data transfer rate: 14.3 kbps.
Controller: 16-bit, one-chip computer
Measurement: voltage by 12 bit, 8-channel Analog-to-Digital converter.

Movement of MSVO, measurement by sensors, and real-time data transmission/reception are controlled through a single digital wireless communication. We developed an original circuit board with the controller and A/D converter. At present, we test transmission/reception of real-time measurement data using thermometer.

We plan to examine movement and wireless communication of our MSVO system around the active vent of Aso volcano in March, 2009. We will also report results of the examination at the meeting.