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Recapitulation on the development of an unmanned ground vehicle ”Mobile Observatory of Volcanic Explosion (MOVE)”

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To observe volcanic explosions safely from near we developed an unmanned ground vehicle ”Mobile Observatory of Volcanic Explosion (MOVE)”, as one of a main project in Grants-in-Aid for Scientific Research ”Dynamics of Volcanic Explosion” conducted from 2002 for 5 years. Since then we repeated its trial and improvement to make ready for coming eruptions, but without an opportunity for it, ten-year durable period passes. The installed equipment is out of date now and some of their repair parts are out of stock. We consider it is unrealistic to maintain MOVE anymore. Here we recapitulate the MOVE project to terminate it.

We planned to remodel an existing remote-controlled vehicle, and selected power shovel MPX10 by Hitachi Construction Machinery Co., Ltd. designed to work at dangerous disaster site under operator’s eyes within 100m distant. We initially installed four cameras and enhanced wireless controlling system to operate MOVE from 2 km distant. The operator runs MOVE based on transmitted camera images. The position of MOVE is displayed on the map at the operation base using transmitted GPS data. To enhance the controllability two cameras for monitoring tiltmeter and viewing back, respectively, are added later.

To catch wide amplitude and frequency range pressure waves, four pressure sensors with different properties were installed; piezo-electric pressure transducer, gauge-type pressure sensor, low frequency condenser microphone and a differential pressure sensor. A quick-response thermocouple was also installed to measure the temperature of volcanic blast and surge. Acquired signals are stocked into the installed multimedia acquisition system and simultaneously displayed at the operation base graphically. The stocked digital data can be sent to the observation base on demand.

A heat insulation box was mounted to contain remote-controlling and observation equipment and their power supplying batteries. A grapple was substituted into bucket on end of the arm to remove obstacles, install an observation system on the ground and collect rock samples.

We also developed operation base car equipped with operation system and telescopic antenna pole. It shortened the setting up and closing time greatly, made operation possible even under bad weather and extended flexibility to select operation base location.

During the past ten years we maneuvered only four times on volcanoes, two times each at Aso volcano and at Izu Oshima. In addition to the cost problem, there seemed no other appropriate test field to apply MOVE. Through the maneuvers we recognized that it is much difficult to run MOVE on volcanoes than expected. Especially disconnection of image transmission radio by topographic interruption is serious. Even on Aso volcano we could not complete to run MOVE to crater rim. On Izu Oshima, to the contrary, we avoided radio disconnection by moving the operation base car to new position where there was no topographic interruption against MOVE and succeeded in running it to crater rim. We confirmed over 2.3km remote controlling is possible if there is no topographic interruption to hinder radio transmission.

It is hard to say we achieved our aims satisfactory without bringing MOVE into observation. But we clarified hurdles such as restriction by radio law and necessity of operating organization, in addition to technological difficulties. We are also sure we have blazed a trail for future unmanned exploration. In fact some unmanned vehicles, such as SKY-1 and Homura, have been developed later for volcanic observation, and ”Observation Robot Symposium and Field Experiment in Izu-Oshima Volcano” is annually held since 2009. We hope unmanned observation will be practical and the pioneering MOVE project will receive recognition in the future.

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