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Aeromagnetic survey in volcanoes by using autonomously-driven unmanned helicopter

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Conventional aeromagnetic surveys by manned helicopter have a great advantage to obtain geomagnetic data rapidly in almost equally spacing, no matter how the ground is steep or dangerous to get to it. It, however, cannot take a flight below hundreds meter height, and then it obtains only geomagnetic data with less spatial resolution than hundreds meter. Thus it is difficult for conventional aeromagnetic surveys to detect small-scale volcanic activity and events occurred at the near-surface. To overcome this difficulty, the magnetic survey at low-altitude is required. So we try to utilize highly well-controlled unmanned helicopters.

The unmanned helicopter we used is autonomously driven about several kilometers far away from a base station to operate. Accuracy of positioning control is less than one meter by the DGPS. In our survey, it took flights in tens meter height above the ground at the speed of 5-10 m/sec. In the near future, it will be able to detect temporal changes of geomagnetic field by frequent flights on the same tracks.

A cesium optically-pumping magnetometer was used to measure geomagnetic intensity. To install it at the helicopter, we conducted many tests to see the best way, such as stinger-type installation and bird-type one. Finally, we took a bird-type installation and the magnetometer is hung about 5 meter below. By using this system, we conducted aeromagnetic surveys at Mt. Asama, Izu-Oshima volcano, and Sakurajima volcano so far.

At the survey in Izu-Oshima island, we made flights in a whole caldera of Mt. Mihara at tens meters spacing. As the result, we found the highly-magnetized narrow zones in NW-SE directions. This direction is coincident with stress field orientation, and this highly-magnetized area may be solidified magma, rising up in dykes.

In this presentation, we showed our system and observation in the fields, mainly the results of Izu-Oshima.

Keywords: aeromagnetic survey, volcano, unmanned helicopter