

Research method development by using UAV over restricted areas of volcanoes

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It is known that deformation and tephra fallout by volcanic eruptions could cause severe geographical changes around the crater. If some volcanic ash emitted from the crater can be collected, we have a greater chance of getting information on its magma reservoir and its eruption type, and by examining the contents of volcanic ash, we may be able to assess the possibility of an occurrence of a secondary disaster such as debris flows.

We have been conducting a series of field test for collecting ash or gravels from volcanic area, obtaining images at crater and creating DSM by using UAV and other devices. In this study, we present methods and results based on a field test conducted in Sakurajima volcano, in December, 2014.

The UAV used in this project is ZionQC730 by Enroute Co., Ltd., equipped with four pieces of propellers. At Sakurajima, we send this device from lower Kurokami River to over Showa crater. Translational distance from take-off point to the crater was about 3,700 m, at altitude 1,200 m, flying distance of 8,000 m with speed of 10 m/s, and flight duration was approximately 20 minutes per flight. 56 % of the battery remains after a flight under the wind speed 5 m/s. A total of three flight experiment was conducted to the crater and at each flight, 4K resolution images were successfully obtained. Though lower in resolution, the UAV also provided real-time images during these flights. As stated above, it is possible to obtain high-resolution images at restricted area by these UAVs.

We used 300 images obtained at upstream area of Kurokami River to create DSM by using several utilizing structure from motion (SfM) softwares, and compare them in terms of their accuracies, point densities, and model creation times.

We then assess the difference between existing laser profilers (LP) and our models. As a result, we found that these softwares had a little difference for data accuracies while point densities differed significantly. We also found a few meter differences in vertical direction when not employing GCPs. Usually erupting volcanoes do not allow little time to set them up, therefore we have to resolve the problem as to fix this inaccuracy.

In this project, we attached a special device to UAV to collect samples of volcanic ash from the surface. This device equips a motor to rotate double rollers inwards to collect soils. It has been used successfully in some test fields.

We collected soil from Kurokami River sediment using above device. The rainfall from the previous day might cause harder soil and collecting insufficient amount of sample. In the future, it may be necessary to be able to make changes to the physical structure of the device according to soil conditions.

Keywords: UAV, Sakurajima, Volcano