Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)

HTT33-P01 Room:Poster Time:May 2 16:15-17:30

Mapping active faults by using small unmanned aerial vehicle and structure from motion: a case study on Midori fault

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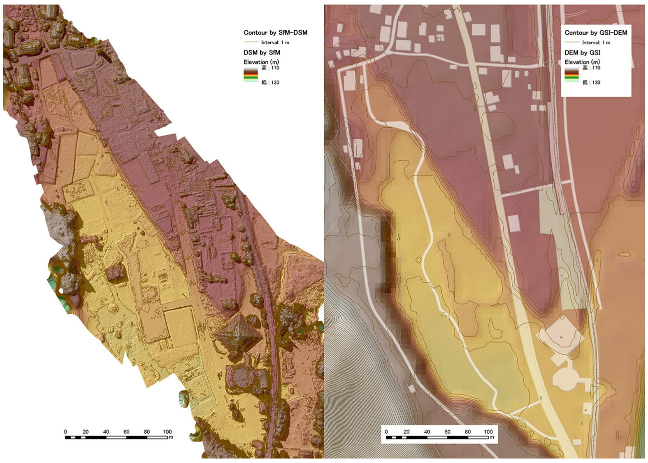
We photographed the geomorphometry of the Midori fault scarp formed by the 1891 Nobi earthquake in Motosu city, Gifu Prefecture (Japan) by using a multirotor radio control helicopter as a small unmanned aerial vehicle (sUAV), and we analysed these images. A digital surface model (DSM) of 0.09 m mesh and an orthophoto with a resolution of 0.03 m were generated from these images by PhotoScan software produced by structure from motion (SfM). A topographic map with 1 m interval contours and a cross-section profile were processed using a DSM produced by ArcGIS. We expect that the new technology will be applied to tectonic landform survey and geomorphology research. In addition, our results should help to ensure flight safety and compliance with the law.

Keywords: structure from motion (SfM), small unmanned aerial vehicle (sUAV), digital surface model (DSM), orthophoto, geomorphometry, midori fault scarp



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HTT33-P02 Room:Poster Time:May 2 16:15-17:30

Generating an orthophoto from SfM calculation with the low-quality air photographs taken in the 1964 Niigata earthquake

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This study shows that generating the orthophoto from low quality aerial photographs using structure from motion (SfM).National Research Institute for Earth Science and Disaster Prevention (NIED) is archiving a lot of old aerial photographs and its original roll films. However, some films are deteriorating. One of them is the 1964 Niigata earthquake's film.This deteriorated photographs were taken 50 years ago, nevertheless, the result of SfM calculating were sufficient quality and generated orthophoto with 0.2 m resolution.As a result, low quality aerial photographs are available to utilize for SfM.

Keywords: structure from motion (SfM), low quality aerial photograph, 1964 Niigata earthquake, ground control point (GCP), orthophoto

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HTT33-P03 Room:Poster Time:May 2 16:15-17:30

Mapping of the fault scarp formed during the 2013 Bohol earthquake by small UAV

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A 5km-long surface fault rupture appeared during 2013 Bohol earthquake (M 7.1) in the Philippine. We took low-altitude air-photos of the ruptures using a small UAV, and made 3D images and contour maps by SfM software. This survey method is a low-cost, easy and effective method for mapping for quick respond field work for unexpected large earthquake damage especially in remote areas in under developing countries.

Keywords: UAV, SfM photogrammetry, earthquake fault, 2013 Bohol earthquake

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Multicopter Aerial Photo Survey of Building Damages by 2013 Bohol Eearthquake in the Philippines

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We demonstrate the effectiveness of multicopter aerial photographing for recording earthquake damages of low to medium-rise buildings. M7.2 shallow inland earthquake occured on Bohol Island in the Philippines on October 15, 2013, which caused thousands of building damages and more than 200 casualties in the western part of the island. Post- earthquake surveys by PHIVOLCS showed the maximum earthquake intensity in Tagbilaran city near the epicentral area was VII in Philippines Eearthquake Intensity Scale, which is equivalent to VI in JMA intensity scale. We visited the island three weeks after the earthquake, to make the damage survey focusing on church buildings using a multicopter. We also carried out aerial photogrammetric survey of the surface rupture of the earthquake fault and the coastal uplift(Nakata et al., JpGU 2014) and the landslide damage of chocolate hill, a distinguishing morphology on the island.

A number of stone masonry churches founded in the 16th century in the Spanish colony times were damaged by the earthquake. The existing building of Baclayon Church, which was constructed in 1727 and known as the oldest church in the Philippines, lost the upper half of the bell tower and the whole front wall of the cathedral. Loboc Church and the adjoined museum in the Loboc city lost most of the side walls except their lower part. Maribojoc Church in the west and Clarin Church in the north of the island collapsed completely. Notable damages are also on non-structural masonry walls confined by RC columns and beams of public buildings, such as Sagbayan city hall and Tubigon city hall.

We used a small and easy-to-fly multicopter named DJI Phantom and a high-resolution and compact digital camera GoPro Hero3 Black Edition for the aerial photographing. We attached the camera facing obliquely down and manually controlled the copter in GPS stabilized mode. We used a FPV (First Person's View) system FatShark Telepoter V3 for watching the camera view. Photos were taken continuously in 2 seconds interval, while the copter was flying around the subjects. We limited the duration of each flight to five minutes and attached propeller guards to the rotors in order to reduce the possible dangers by crash as much as possible because people's activities in the areas around the churches were normal. We had no accident during the survey. We found that FPV is very useful in building damage survey because it can reduce the risk to crash to the building when taking photos, while it is difficult to know the distance from the copter to the subject in manual control from the ground.

The left figure shows the multicopter aerial photos of the damaged Baclayon Church. We can observe the fracture surfaces of the upper structure and its inside which are invisible from the ground. Aerial photographing using multicopter right after an earthquake is an efficient tool to easily get full picture of the damage even when approaching from the ground around a building is difficult. We then processed about 50 aerial photos using an SfM (Structure from Motion) software PhotoScan to reconstruct the 3-D model of the bell tower as shown in the right figure. The techniques enable modeling fractures of buildings and their analyses. The 3-D models are also valuable as digital architectural remains of disasters. Aerial photogrammetry using multicopter and SfM is easier than 3-D measurement using laser scanner. Creating a miniature of damaged building from the digital model using 3-D printer will also be useful for planning repairs and earthquake resistant design of buildings.

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HTT33-P05 Room:Poster Time:May 2 16:15-17:30

Production of vegetation/landcover and dose rate maps by small helicopter and UAV

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The most essential and important information for restoration of the area contaminated by radioactive materials is dose rate and landcover map. The map should cover the SATOYAMA watershed with several hundreds to several kilometers scale, because the life in mountain village depend on water and material cycles in SATOYAMA watersheds and mode of deposition is strongly affected by vegetation type such as deciduous broad-leaved or evergreen coniferous forests. However, large scale maps on present vegetation and dose rate distribution are not available at present, so our team attempts to create vegetation/landcover map and dose rate distribution map by using UAV(Unmanned Areal Vehicle).

Manned helicopter (Robinson R44), radio controlled gasoline engined helicopter (YAMAHA/RMAX), and radio controlled electric multicopter (Minisurveyer MS-06L) are used as platform of dose rate measuring system. Dose rate is measured by radiation detector module (C12137-01, Hamamatsu Photonics) controlled by small laptop computer.

Hyperspectral camera (NH-7, Eba-Japan Co.,Ltd.) and video camera are installed on manned and unmanned helicopter to map precise vegetation and landcover map. In hyperspectral camera operation, both pushbroom and still images are taken. Motion video is captured to get still images, and mosaicked to ortho-areal photo.

Field campaign are carried out two times during August and November in 2013, and various photographing modes three-dimensional dose rate mapping, and dose rate on various landcover such as forest canopy are attempted.

The campaign reveals the feasibility of low-cost, on-demand photographing and dose rate survey buy using UAV. Next subject is implementation to the actual scene. We plan to continue dose rate survey in Yamakiya district, Kawamata Town in Fukushima Prefecture.

Keywords: nuclear disaster, dose rate measurement, UAV, hyperspectral camera, Yamakiya District, FUKUSHIMA