Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

HTT08-01 Room:101B Time:May 26 09:00-09:15

Accuracy evaluation of UAV-measured DSM by RTK-GPS on Midori fault scarp of Neodani active fault, Gifu Prefecture, Japan

SATO, Hiroshi, P.[1*] ; UCHIYAMA, Shoichiro[2]

[1]College of Humanities and Sciences, Nihon Univ., [2]National Research Institute for Earth Science and Disaster Prevention

Accuracy of UAV (Unmanned Aerial Vehicle) -measured DSM (Digital Surface Model, Uchiyama et al., 2014) was evaluated using RTK (Real-Time Kinematic) GPS survey on Midori fault scarp of Neodani active fault, Gifu Prefecture, Japan. The accuracy was evaluated on the surveyed six control points at the accuracy not more than 8 mm in plane. As a result, 3 cm, -8 - -9 cm, -5 - -7cm in difference were found at three points on the top of the scarp. And ca.40 cm, -3 - -4 cm, -0.6 - -2 cm were at three points on the bottom of the scarp. Apart from 40 cm-difference at the one point, approximately less than 10 cm was revealed as measurement accuracy for the DSM.

Acknowledgement
Survey result of RTK-GPS using virtual reference station was given by Tamano consultants Co.,Ltd.

Reference
Uchiyama et al., 2014, Mapping active faults by using small unmanned aerial vehicle and structure from motion software: A case study on Midori fault scarp formed by the 1891 Nobi earthquake, Active fault study, 40, 35-41.

Keywords: fault, UAV, GPS, RTK, DSM, VRC

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

HTT08-02 Room:101B Time:May 26 09:15-09:30

Comparison of accuracy using various cameras and Structure from Motion

KOBAYASHI, Yuusuke[1*] ; ISHIKAWA, Masaki[2] ; WATANABE, Teiji[3]

[1]Graduate School of Environment Hokkaido Univ., [2]Graduate School of Environment Hokkaido Univ., [3]Hokkaido University

Recently, the significance of Unmanned Aerial Vehicle (UAV) and Structure from Motion (SfM) has been increasing in geoscience field to understand geomorphological phenomena. These two new technologies can be used inexpensively, easily, rapidly and automatically in comparison to a traditional photogrammetry method, so that geomorphological changes that are caused by various agencies can be estimated at close interval. For these reasons, geomorphological information (e.g. DEM and Orthophotograph) can be made flexibly to suit researcher preferences. Most mountain national parks in Japan have been suffered from serious trail erosion for long time. Especially, some mountain trails in Daisetsuzan National Park in Hokkaido, northern Japan, have been eroded in a few meters in depth. This serious soil erosion bothers national park managers, mountain hikers and also alpine vegetation. It is important for park managers to accurately and easily understand that eroded soil volume and geomorphological changes. For the purpose of the management, this study demonstrated two new technologies and evaluated quality of DEMs and orthophotographs. This study aims: (1) to demonstrate two new technologies under various conditions, and (2) to understand differences of accuracy in some cameras and some software to make three-dimensional data.

This study used two methods to take photographs: (1) UAV (DJI Phantom2 +Vision) at 5 m, 10 m and 20 m flying height; and 2) a monopod at distance of 1.5 m and 3 m from the ground surface at 24 viewpoints. In order to compare difference of accuracy of cameras, Ricoh GR, Ricoh CapioR7 and DJI camera were used with UAV; and Ricoh GR, Canon power shot SX150IS, NikonD90, Panasonic LUMIX DMC TZ-60, Ricoh CapioR7, SONY Cyber-shot DSC-TX5, Ricoh GR, and Panasonic LUMIX DMC-GX1 camera were used with monopod. Sixty pictures were taken by the cameras on UAV, and 24 pictures were taken by the cameras on the monopod. Moreover the following software was used for making DEMs and orthophotographs: Visual SfM (free), Photo Scan Pro (commercial) and 123Dcatch (free). In place of the actual micro-topography, artificial sheet and blocks were placed on a flat ground for targets when taking photographs to evaluate absolute positional accuracy.

The analysis of the photographs taken with UAV by Photo Scan Pro shows that the average absolute positional error score was almost the same in Ricoh GR (0.001 cm) and Ricoh CapioR7 (0.042 cm) at the 5-m flying height. But, at the 10-m flying height the average absolute positional error score was as large as 1.371 cm in Ricoh CapioR7. On the other hand, the score for Ricoh GR was 0.039 cm. At the 20-m flying height, the score for Ricoh GR was 0.066 cm. In this flying height, Ricoh CapioR7 was not suitable due to bad resolution. DJI camera was not suitable in all cases. When using a monopod, the average absolute positional error score was less than 1 mm in all cameras from distance of 1.5 m (Ricoh GR: 0.89 mm, Canon Power Shot SX150IS: 0.71 mm, Nikon D90: 0.68 mm, Panasonic LUMIX DMC TZ-60: 0.68 mm, SONY Cyber-Shot DSC-TX5: 0.65 mm, Ricoh CapioR7: Not suitable). The results show that UAV-SfM is a useful method for national park managers and even mountain hikers to obtain high-resolution models by using inexpensive cameras to record trail conditions.

Keywords: Structure from Motion, UAV

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

HTT08-03 Room:101B Time:May 26 09:30-09:45

Tsunami-induced bedrock erosion and sediment deposition on uplifted coastal bench: Cape Todogasaki, eastern Japan

HAYAKAWA, Yuichi S.[1*] ; OBANAWA, Hiroyuki[2] ; WASSMER, Patrick[3] ; SAITO, Hitoshi[4] ; OGUCHI, Takashi[1]

[1]Univ. Tokyo, [2]Chiba Univ., [3]Univ. Strasbourg, [4]Kanto Gakuin Univ.

An uplifted coastal bench at an elevation of ca. 20 m a.s.l. is located around Cape Todogasaki of the ria-type rocky coast in Sanriku, northeastern Japan. Tsunami waves induced by the 2011 Tohoku Earthquake were high enough to spread over the 20-m high terrace. To clarify the effects of tsunamis on the terrace surface micromorphology, we performed field measurements of structure-from-motion multi-view stereo (SfM-MVS) photogrammetry using an unmanned aerial system (UAS), composed of a digital camera mounted on a small unmanned aerial vehicle (sUAV), and terrestrial laser scanning (TLS). Global navigation satellite system (GNSS) rover was used to obtain geographical coordinates (centimeter accuracies) of ground control points for the georeferencing of the UAS and TLS data. Using digital elevation models (DEMs) with a 20-cm resolution generated from the point clouds of UAS and TLS, micromorphology of the terrace surface was analyzed. Despite limited basin area draining into the terrace, erosional features in the bedrock were identified. These features appear to be formed by the tsunami flow. Furthermore, sedimentological characteristics of small thin clasts and large (>2 m) boulders located on the terrace were examined in the field, revealing that the sediments are likely disloaded from in-situ bedrock at the terrace edge. Evidences of landward flow were also found from the sediment structure. We conclude that the uplifted terrace surface underwent erosion by not only the 2011 tsunami but also repeated significant tsunamis in the past, some of which could have been much larger than that in 2011.

Keywords: tsunami, UAS, TLS, erosion, sediments

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

HTT08-04 Room:101B Time:May 26 09:45-10:00

High-resolution multibeam bathymetric survey for coastal seafloor geomorphology and related sciences

KAN, Hironobu[1*] ; NAGAO, Masayuki[2] ; TOGUCHI, Ken[3] ; HORI, Nobuyuki[4] ; URATA, Kensaku[5] ; FUJITA, Kazuhiko[3] ; YOKOYAMA, Yusuke[6] ; NAKASHIMA, Yosuke[7] ; HASEGAWA, Hitoshi[8] ; NAKAI, Tatsuro[8] ; GOTO, Kazuhisa[9] ; KATAGIRI, Chiaki[10] ; ONO, Rintaro[11] ; SINNIGER, Frederic[12] ; PRASETIA, Rian[3] ; HARII, Saki[3] ; IGUCHI, Akira[13] ; SUZUKI, Atsushi[2]

[1]Graduate School of Integrated Sciences for Global Society, Kyushu University, [2]Institute of Geology and Geoinformation, AIST, [3]University of the Ryukyus, [4]Nara University, [5]Osaka University of Economics and Law, [6]AORI, University of Tokyo, [7]Ariake National College of Technology, [8]Kokushikan University, [9]IRIDeS, Tohoku University, [10]Okinawa Prefectural Museum and Art Museum, [11]Tokai University, [12]JAMSTEC, [13]Okinawa National College of Technology

The geomorphology of shallow coastal regions has been modulated by repeated subaerial and submarine processes during glacio-eustatic sea-level change. However, in contrast to the vast knowledge that has been accumulated regarding terrestrial landforms, few previous studies have dealt with shallow seafloor landforms, which represent former terrestrial landscapes modified by present marine processes, from a geomorphological perspective.

A broadband multibeam echosounder (Sonic 2022, R2 Sonic, LLC) and its accessory system were introduced to H. Kan's laboratory in 2010 using JSPS Grant-in-Aid for Scientific Research A. We have carried out our bathymetric survey in Kume, Ishigaki, Kikai Islands and the southeastern and northwestern coasts of Okinawa Island in the Ryukyus, southwestern Japan since 2010.

The Sonic 2022 has a variable ultrasonic frequency of 200 to 400 kHz, 256 ultrasonic beams and selectable swath coverage of 10 to 160 degrees. The typical ultrasonic beam widths parallel and orthogonal to the direction of travel are within one degree of each other when an ultrasonic frequency of 400 kHz is selected. We used a VS111 GPS compass system with A20 and A30 antennas (Hemisphere Inc.) combined with a dynamic motion sensor (DMS-10, Teledyne TSS Ltd.), a sea surface sound velocity sensor (miniSVS, Valeport Ltd.), a sound velocity profiler (MicroSVP, AML Oceanographic Ltd.). Overlap of at least ˜20% (typically ˜50%) was implemented throughout the bathymetric survey to ensure 100% coverage of the surveyed area. The minimum and maximum depth was 1m and 400m, respectively. The HYPACK2010 software was used for both hydrographic survey and data processing. IVS3D Fledermaus was used for three-dimensional visualization.

We conducted geomorphological studies of the coastal seafloor in the coral reef areas of the Ryukyu Islands based on our high-resolution bathymetric map with a grid size of 1 m combined with SCUBA diving observations. For example, the submerged tropical karst features were discovered in Nagura Bay, Ishigaki Island (Kan *et al.* 2015). This is the first description of submerged humid tropical karst using multibeam bathymetry. Along with the geomorphological studies, we have also started biological and archeological studies in our bathymetric areas to promote interdisciplinary researches which link natural and human sciences.

Keywords: multibeam ecosounder, coastal seafloor geomorphology, biology, archaeology, coral reefs, Ryukyu Islands