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

HTT08-02 会場:101B 時間:5 月 26 日 09:15-09:30

Structure from Motion および様々なカメラを用いた精度比較
Comparison of accuracy using various cameras and Structure from Motion

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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