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UAV による神浦川の水深推定

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Water depth Estimate in Kounoura River Using UAV

by

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The history of riverbed estimation using UAV (Drone) has just started. The authors have studied distribution map of vegetation using UAV, investigation of earthquake disaster, estimation of water quality, etc. Recently, making the riverbed area visually by drone would be clearly. In this study, the depth of the river was estimated using DEM (Ministry of Land, Infrastructure and Transport) and DSM (UAV). Phantom 4 Professional was used for UAV. ArcGIS was used for analysis, PhotoScan was used for image combination and creation of 3D model. As a result, the water depth estimation of UAV in the Kounoura River approximately was calculated by subtracting the DEM data and the DSM data using UAV and multiplying by the refractive index of light (1.33). Although the result consideration of this research was calculated one-dimensionally, further effects can be expected by using the three-dimensional method of PhotoScan and ArcGIS.

Key words: *Remote Sensing, DEM, DSM, GIS*

1. Introduction

The history of riverbed estimation using UAV (Drone) is still not enough. In the past, underwater visualization processing at Kiso river using UAV was performed. (Harada, 2016) Theoretically, obtaining the actual water depth was possible by multiplying apparent water depth data presumed from photographs by the photogrammetry technique times by 1.33 (refractive index of light). The correction was also found statistically. For sure, this method is highly accurate, however, removing the noise of the photograph and measuring the water level was necessary. In conclusion, measurement with only the drones is insufficient. Thus, it took for relatively long time to study correctly. However, in our research, the water depth estimation result in the Kounoura River, Nagasaki prefecture, was measured only by drone. This would make the researcher take it easy. For considering, I further thought that the water depth estimation should be simple without amount of budget. Photo data of UAV shows DSM (Digital Surface Model), which is different from DEM. The authors made an inference that DSM data by UAV minus data (DEM) by the Ministry of Land, Infrastructure and Transport (MLIT) subtracted the apparent water depth. multiplying 1.33 times was necessary to obtain the actual water depth.

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2. Methods

2.1 Equipment and software

For taking pictures, UAV was used (Phantom 4 professional). Phantom4 professional is shown in Fig.1. Agisoft PhotoScan was the software used for photosynthesis. DSM data of UAV and ArcGIS was the software used for processing DEM data of the Geographical Survey Institute of Land, Infrastructure and Transport. In this research, DSM (Digital Surface Model) was calculated by using PhotoScan.

Fig.1 UAV (Phantom4 professional)

2.2 Survey target area

The authors investigated in the Kounoura River, Saikai-shi, Nagasaki prefecture. Kounoura River was an area connecting upstream and downstream as seen from the sky, covered with forests and trees, and shooting with UAV was very difficult. Therefore, only in the downstream area (within 2000 m from the sea) was only estimated. Fig. 1 is a photograph taken by the digital camera of the downstream area of the Kounoura River. Similarly, Fig. 2 shows the picture taken by UAV. This shows downstream area of the Kounoura River, showing that the Kounoura River was very clear and transparent.

Fig. 1 Downstream area of the Kounoura River (digital camera)

Fig. 2 Downstream area of the Kounoura River (UAV)

2.3 Application of river topography and material monitoring by UAV

Harada's research on river topography and riverbed material monitoring by UAV (2017) published by Gifu University was the applied for this research.

The generalized model of river topography measurement shown in Figure 3-(b) is an excerpt of only the water depth correction DEM part of the river topography model made by Gifu University in 2017. On the other hand, Figure 3-(a) is a river topography measurement method that authors used for water depth estimation in

this research. The major difference between Fig. 3-(a) and Fig. 3-(b) was collecting data. while the former method(3-b) was conformed to actual measurement data collection actually performed by boat with engine, on the other hand, the latter is DEM taken from altitude by the Ministry of Land, Infrastructure and Transport (MLIT) and DSM taken with UAV are used for the study. Because of this, measurement of water depth only with UAV was calculated without actually measuring water depth with a boat.

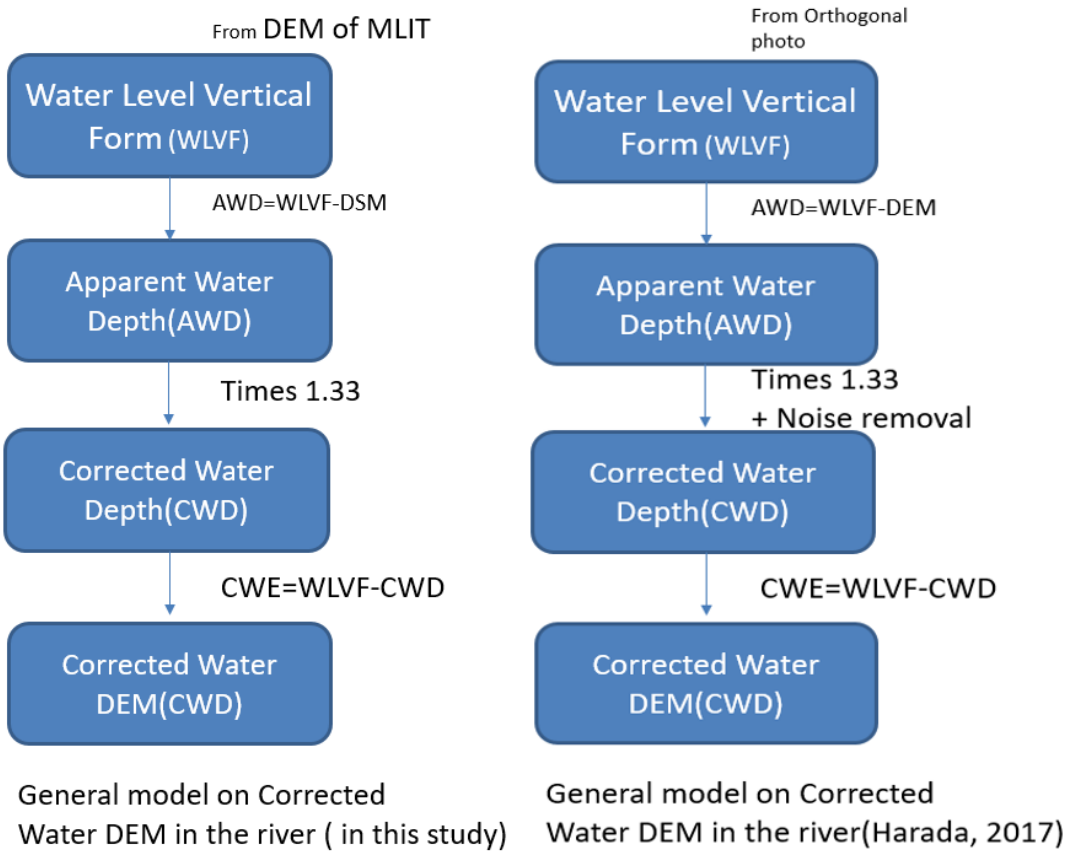


Fig.3 Left picture is 3-(a) Right pucture is Fig3-(b)

3. Results

The results were summarized as follows. Figure 4 was a combination of DEM around the Kounoura River from the Ministry of Land, Infrastructure and Transport. Figure 5 shows the satellite data of rivers of the Kounoura River. Figure 6 shows DSM from UAV. Figure 7 shows the result of subtracting the DEM of the Ministry of Land, Infrastructure and Transport from DSM, and multiplied by 1.33. Fig.8 shows a graph of water depth estimate.

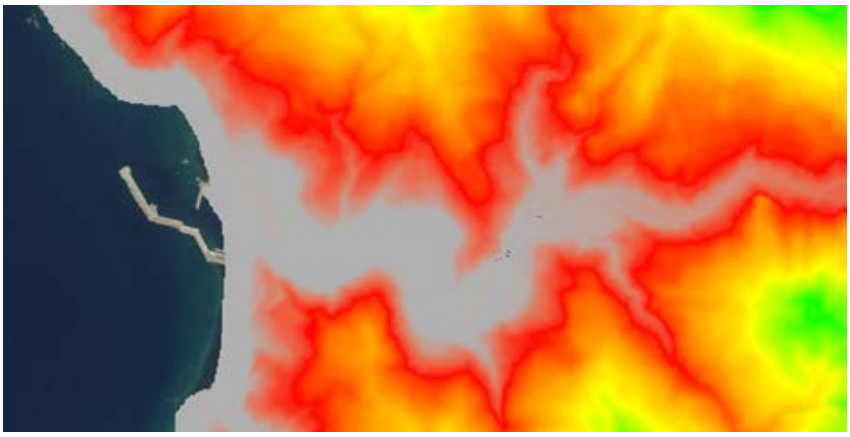


Fig. 4 DEM data from the Ministry of Land, Infrastructure and Transport(MLIT)

Fig. 5 Satellite imagery of Kounoura river (Arc Map)

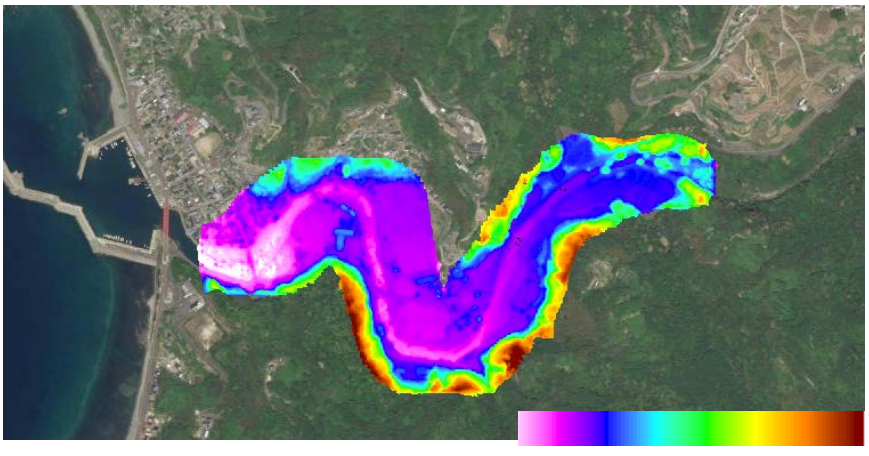
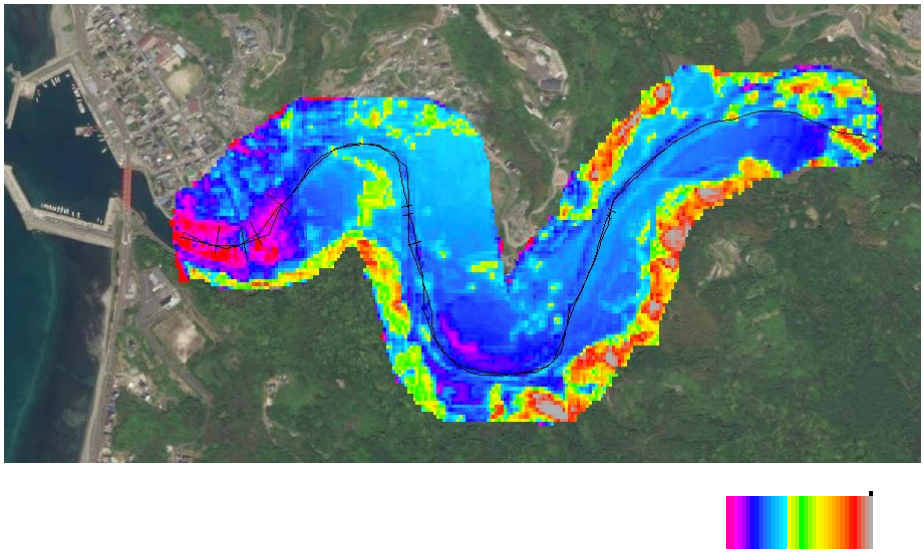


Fig. 6 DSM data by UAV



Deep Shallow

Fig. 7 Water depth Estimate (Arc GIS)

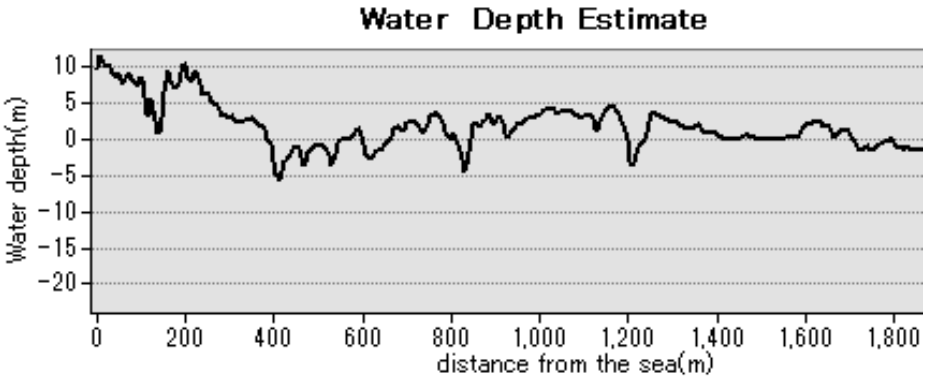


Fig. 8 The graph of Water Depth Estimate

2.3 Automatic navigation of UAV

For Phantom 4 professional used in this research, we used full automatic application software called Litchi for DJI. While keeping the altitude of 150 m, the speed of UAV was nearly constant and surveying was carried out, It means that the accuracy is relatively high. This made carrying out highly accurate surveying possible fully automatically and by itself.

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