Application to Photogrammetry of Automatic Navigation for UAV

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1. Introduction

UAV has made rapid progress in surveying in recent years. In this research, UAV with 5 bands: RGB, near infrared, and short wavelength infrared was automatically navigated and applied to photogrammetry.

2. Methods

This research was conducted in the ground, Isahaya Bay, and Konoura river. First, the route maps with altitudes on PC using automatic navigation software, Litchi. Next, using UAV (Phantom 4.0), aerial photographs were taken at an altitude of 150 m. Phantom4 is shown in Fig. 1. Band composition is shown in Table 1. Two filters, IR72 and IR90, were used. IR filter is shown in Fig. 2. An automatic navigation route in the Isahaya Bay is shown in Fig. 3. The aerial photos with PhotoScan were synthesized. The synthesized images were analyzed in 2D and 3D using ArcGIS and ArcScene.

3. Results

The RGB data of buildings with the ground in Nagasaki University is shown in Fig. 4. With PhotoScan, measuring the distance, the latitude-longitude, altitudes, and DEM could be made easily. Images with GPS information could be analyzed by ArcGIS. In addition to RGB, near infrared and short-wavelength infrared bands were also obtained. Fig. 5 shows a near infrared image in the Isahaya bay. Fig. 6 shows a short-wavelength infrared image in Konoura river. Fig. 7 shows water temperature in the Konoura river.

4. Discussion

4.1 Temporal resolution

In manual navigation, making complicated settings for altitudes and routes of the site was required. On the other hand, in automatic navigation, the routes and altitudes were determined on PC and then at the site, reducing time of day was obtained.

4.2 Expansion of scopes

The altitude varied according to the photograph. It took only the distance of 200 m with a straight line. On the other hand, in automatic navigation, the distance was expanded to approximately 1.4 km. The maximum straight line flight distance of Phantom 4.0 was 2.2 km in Isahaya Bay in the study. In addition, the total maximum flight distance was 8.0 km. UAV left 30% or more battery in the study.

4.3 IR filter

With manual navigation, when the filter was attached was difficult to visually observe. Also, UAV could not shoot enough pictures of IR 72 and IR 90 and the distance to skip UAV was further narrowed. On the other hand, in automatic navigation, UAV flies the same route as RGB, and capturing a photo at the same position as RGB could be possible.

4.4 Litchi

First of all, the automatic navigation application (*Litchi*) took off to the set altitude and started at the start point in the horizontal direction. The landing position can be specified by the position with tapping. Automatic photographing function would be conducted in next research.

5. Conclusions

By using the automatic navigation application, *Litchi*, RGB and IR were taken in the same place. The time was shortened greatly. The range was seven times as much as the manual navigation by visual flights. From the above, automatic navigation is required in the systematic study of UAV photogrammetry.

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Fig. 1 Phantom4

Table. 1 Band composition

Band	Wavelength(nm)	Color
1	450-520	Blue
2	520-600	Green
3	630-690	Red
4	720-900	Near Infrared
5	900<	Short Infrared

Fig. 2 IRfilter

Fig. 3 Automatic navigation route

Fig. 4 RGB in Nagasaki University

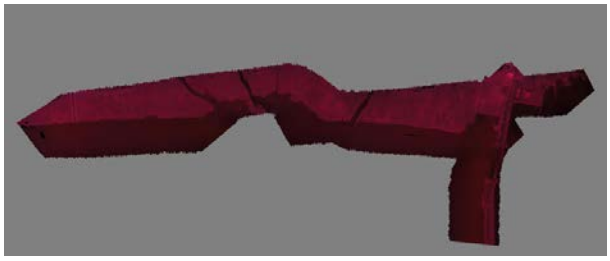

Fig. 5 Near Infrared in the Isahaya bay

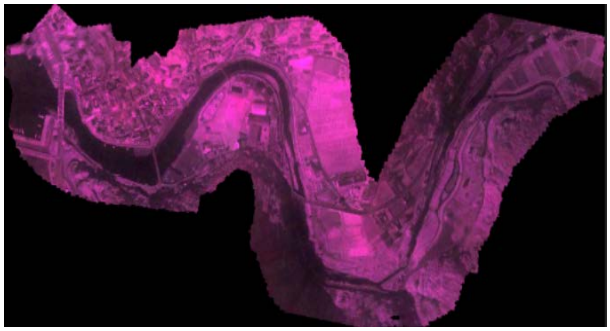

Fig.6 Short-wavelength infrared in Konoura river

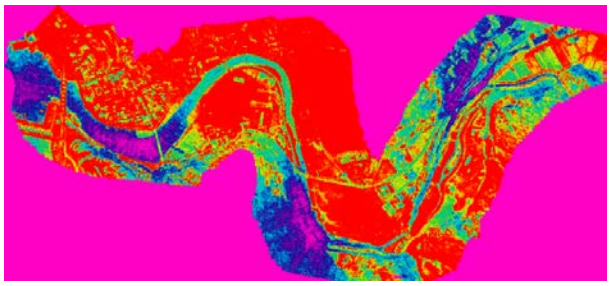

Fig.7 Water temperature in Konoura river

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