DIGITAL MAPPING USING AERIAL DIGITAL CAMERA IMAGERY

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ABSTRACT:

Lately, photogrammetry using aerial digital camera has been utilized widely in the fields of a plan, development and management for a national land in advanced countries. There are various benefits using photogrammetry with digital camera imagery, such as the prevention of differential stretch errors when scanning analogue films as well as the cost-cutting according to banning the use of analogue films. Most of all, one of the biggest benefits is to be able to store, maintain and manage digital imagery in the computers without any procedures.In this research, the characteristics which were analyzed on the basis of analysis of properties and application cases in digital camera imagery were investigated and a large-scaled map with aerial digital camera imagery was made. In order to analyze accuracies of results for the production of digital map using digital camera imagery, the digital topographic maps of 1:1000 scale which was produced by Korea National Geographic Information Institute (KNGI) were used. And then the accuracy between digital map of KNGI and generated map from digital camera imagery was compared and assessed. From the results of this study, it would carry out the accuracy analysis for digital map by digital imagery in a wide area and it would be able to increase the uses of the production and application of digital map using digital camera imagery.

1. INTRODUCTION

Surveying and mapping are very important techniques for development and management of a national land. In order to collect geospatial information, various survey techniques are required. These techniques from measurements of the moon and stars, via a term of using invar tape or a simple instrument to GPS surveying or remote sensing have been developing rapidly. Aerial photogrammetry started in the mid and late 19th century in France. Developing the metric camera in the opening years of the 20th century brought the epoch-making turning point to mapping wide area, which became the most efficient and economical surveying technique to produce topographic map in most countries.

The aerial photogrammetry is used in many spheres. And the development of techniques(such as aircraft, computer, etc.) changes it from mechanical method and analytical method to digital method.

Nowadays, although techniques and products to relate the aerial photogrammetry in Korea is used in many parts of a digital environment, aerial photogrammetry using existing analogue camera is still conducted, besides the scanning procedure to change from analogue imagery to digital imagery has to go forward. This procedure of scanning the film wastes expenses and time. Furthermore it brings some errors sometimes.

However, if aerial photogrammetry using digital camera is conducted, it needs no more film. So economical efficiency of development, operation expense, space, and time can be improved, in addition the procedure of scanning to acquire digital imagery is enabled to abbreviate and prevent errors of scanning procedure. Also, imagery of digital camera is digital data, it makes easy to save and manage the data.

Consequently, this research would be present foundation data and reinvigorate relative industry as constructing of geospatial information data about research area and analyzing accuracy of digital camera imagery.

2. DIGITAL MAPPING USING AERIAL DIGITAL CAMERA IMAGERY

The process of large-scaled digital mapping using digital camera is more effective and economical method than the other method using analogue aerial photography, because of omission and simplification of scanning, ground control point surveying, aerial triangulation.

In this research, digital mapping has been performed about research area using aerial digital camera imagery. Economical effectiveness and efficiency of digital mapping was proved by executing the accuracy analysis. Figure 1 shows the mapping process comparison of analogue versus digital.

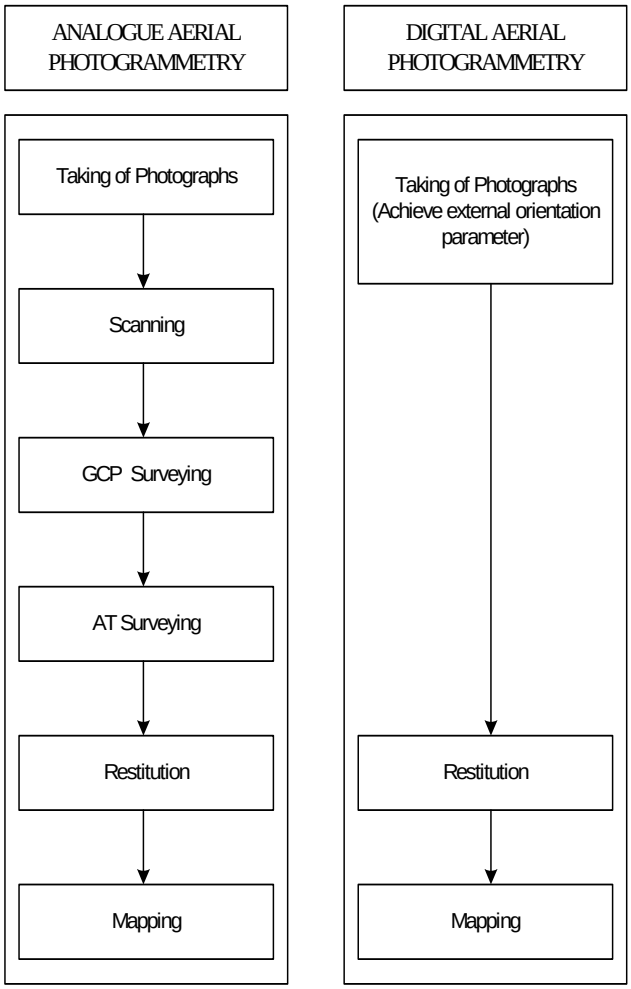

Figure 1. Mapping process comparison

For digital mapping in research area, a display of three-dimensional modeling and create of vector element by ISSD (Image Station Stereo Display) of Intergraph Corp. was used. Figure 2 shows the working view of digital restitution.

In this research, digital restitution was conducted to use organized stereo model. Generally the digital restitution was a realistic description of digital restitution data without topographical exaggeration or displacement. Based on such digital restitution data, the digital mapping was conducted to use digital imagery, existing map, and geospatial information of documentation.

Figure 2. Working view of digital restitution

Figure 3 shows a digital restitution by layer classification. Figure 4 shows the final product of digital restitution using digital aerial imagery.

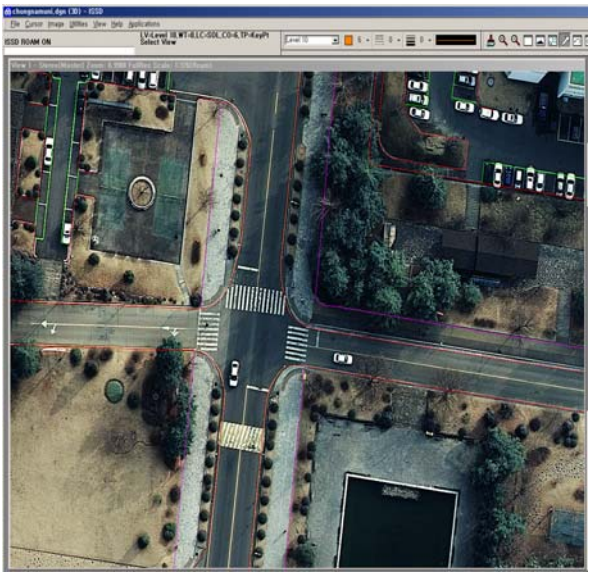

Figure 3. Digital restitution by layer classification

Figure 4. Final product of digital restitution

Figure 5. A distribution chart of check points

3. ACCURACY ANALYSIS

In this research, the digital mapping of large-scale using aerial digital camera imagery which was improved of practical efficiency compared with existing analogue method was performed. And it would be present foundation data and reinvigorate relative industry. For this purpose, digital restitution using digital camera imagery was constructed. And it was compared with a scale of 1 to 1,000 digital map which was produced by Korea National Geographic Information Institute and accuracy analysis of it was conducted.

Figure 5 shows a distribution chart of check points for accuracy analysis. Table 2 shows deviations of check points. And figure 6 shows accuracy of product.

No.	Feature	Digital map of NGII		Product by digital imagery		Deviation	
		X	Y	X	Y	dx	dy
1	Road	351119.1300	4026097.6300	351119.0500	4026097.5000	0.0800	0.1300
2	Road	351783.0100	4026403.7800	351783.0300	4026403.7000	-0.0200	0.0800
3	Road	351556.6800	4025887.1200	351556.6700	4025887.0400	0.0100	0.0800
4	Road	351016.3800	4025844.1000	351016.3808	4025844.1898	-0.0008	-0.0898
12	Road	351591.9830	4026095.3150	351592.3400	4026095.5000	-0.3570	-0.1850
5	Structure	351035.2200	4025852.3400	351035.2300	4025852.4900	-0.0100	-0.1500
6	Structure	351244.8900	4025843.8100	351245.1000	4025843.7200	-0.2100	0.0900
7	Structure	351612.6400	4025930.9500	351612.9000	4025931.1900	-0.2600	-0.2400
10	Structure	351709.5900	4026711.0500	351709.8400	4026711.0300	-0.2500	0.0200
15	Structure	351719.1800	4026498.2400	351719.3600	4026498.1000	-0.1800	0.1400
17	Structure	351660.6300	4026253.4800	351660.4000	4026253.8000	0.2300	-0.3200
8	Etc. (Playground)	351390.2100	4026649.1400	351390.2100	4026648.9400	0.0000	0.2000
11	Etc. (Tower)	351573.5900	4026173.3500	351573.7018	4026173.4115	-0.1118	-0.0615
29	Etc. (Tower)	351518.4016	4026316.1901	351518.2250	4026316.5069	0.1766	-0.3168
31	Etc. (Fence)	351397.9850	4026787.2800	351398.2500	4026787.5900	-0.2650	-0.3100
32	Etc. (Playground)	351254.9585	4026558.5999	351255.1000	4026558.6800	-0.1415	-0.0801
34	Etc. (Pond)	351582.1300	4026147.9800	351581.9200	4026147.9200	0.2100	0.0600

Table 2. Deviations of check points

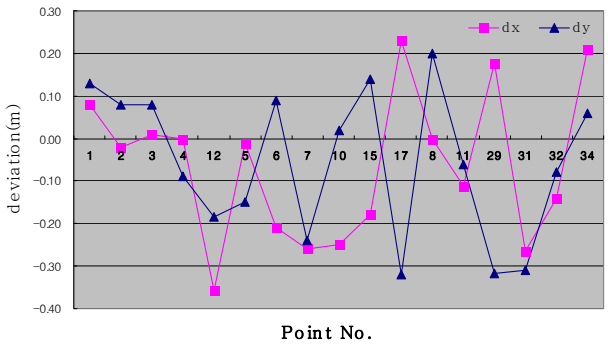

Figure 6. Accuracy of product

In this research, the results of accuracy analysis using digital camera imagery showed the RMSE of 0.1891m in X and 0.1825m in Y. These are the results in acceptable accuracy of the detail standard of Korea public surveying published in January 1st, 2004 (2003-326 published by Ministry of Land, Transport and Maritime Affairs). And It proved that a scale 1 to 1,000 digital mapping using digital aerial imagery would be able to produce.

In figure 6, one-sided directional elements of no.6, no.10, no.12 and no.29 were out of ±0.2m within the permissible accuracy required for the mapping on a scale of 1 to 1,000 on the mapping rule notified by the National Geographic Information Institute of Korea. But these are confirmed to the region where is difficult to interpret in digital imagery. And the result of no.7 and no.32 was estimated to be partial change of topography by different time.

4. CONCLUSIONS

In this research, possibility of large-scaled digital mapping using aerial digital camera was proved and that would be contributed to revitalization of industries by presenting foundation data. The results of the accuracy analysis using aerial digital camera imagery are following.

The results show some good RMSE of 0.1891m in X, 0.1825m in Y. These results are in allowable accuracy that is published by the detail standard of public surveying in Korea, therefore it would be possible to apply digital image on a scale 1 to 1,000 digital mapping.

In the future, if it conducts globally research considering topographical feature and additional accuracy analysis of three-dimensional position by GPS surveying, it would be possible to indicate more objective and accurate result.

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