GENERATION OF GEO-SPATIAL INFORMATION USING KOMPSAT-2 IMAGERY

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ABSTRACT ... KOMPSAT-2 is the seventh high-resolution satellite in the world that provides both 1m panchromatic images and 4m multispectral images of the GSD. It is expected to be used across many different fields including digital mapping, territorial and environmental monitoring.

However, due to the complexity and security concern involved with the use of the MSC, the use of KOMPSAT-2 images are limited in terms of geometric data, such as satellite orbits and detailed mapping information.

This study aims to generate the DEM and orthoimage by using the stereo images of KOMPSAT-2 and to explore the applicability of geo-spatial information with KOMPSAT-2.

In order to ensure generation of DEMs of optimal accuracy, the RPCs data and a suitable number of GCPs were used. The accuracy of DEM generated in this research compared with DEM generated from 1:5,000 digital map. The mean differences between horizontal position of the orthoimage and the digital map data are found to be ±3.1m, which is in the range of ±3.5m, within the permitted limit of a 1:5,000 digital map. The results suggest that DEM can be adequately used to produce digital maps under 1:5,000 scale.

KEY WORDS: KOMPSAT-2, Digital Elevation Model, Orthoimage, Rational Polynomial Coefficient

1. INTRODUCTION

Recently, a shift moving from vector-based two-dimensional geospatial information to raster-based three-dimensional geospatial information has been observed. This has in turn promoted the utilization of high-resolution satellite images in many different fields. KOMPSAT-2(KOrean MultiPurpose SATellite-2) is the seventh high-resolution satellite in the world that provides both 1 meter panchromatic images and 4 meter multispectral images of the GSD(Ground Sample Distance). It is anticipated to be used across many different fields including mapping, territory monitoring and environmental watch.

However, due to the complexity and security concern involved with the use of the MSC(Multi-Spectral Camera), the use of KOMPSAT-2 images are limited in terms of geometric data, such as satellite orbits and detailed mapping information.

This study aims to generate the DEM(Digital Elevation Model) and orthoimage by using the stereo images of KOMPSAT-2, and to explore the applicability of geo-spatial information with KOMPSAT-2.

2. GENERATION OF GEOSPATIAL INFORMATION BY USING KOMPSAT-2 IMAGES

2.1 Selection of the studied area

A typical agricultural area consisting of agricultural land, mountain, and buildings in Damyang-gun, Jeollanam Province has been selected for this study.

Table 1. Specification of KOMPSAT-2 images

Category	Content
Study Area	• Damyang-gun, Jeollanam Province
Date of acquisition	• February 23~26, 2007
Row images	• GSD 1m : PAN • GSD 4m : R, G, B, NIR
Level	• 1R(radial correction)
Stereo	• stereo image
Image area	• Left image : about 276.075 ㎢ • Right image : about 268.976 ㎢
Overlap	• Left : 83.1%, right : about 85.2% • Average : 84.2%
Base-height ratio	• about 0.0031

KOMPSAT-2 images are able to obtain the 1m panchromatic images and 4m multispectral images. In this experiment the 1meter panchromatic and 4 meter multispectral stereo images, header information, and RPC(rational polynomial coefficient) data are used for the study area. Table 1 shows the specification of the KOMPSAT-2 images.

The KOMPSAT-2 images are stereo images obtained from February 23 to 26 in 2007. The area of the left image is about 276.075 ㎢, and that of the right image is about 268.976 ㎢. The overlap is about 84.2%.

In order to analyze the accuracy of the generated geospatial information, 1:5000 digital maps was used as a reference data.

Figure 1. 1m panchromatic image of KOMPSAT-2

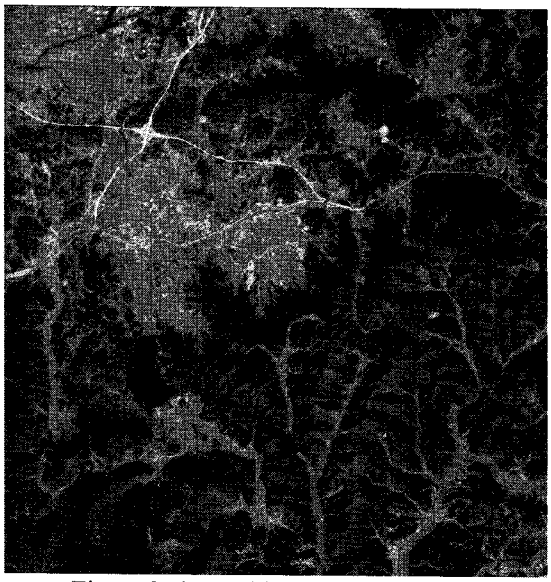

Figure 2. 4m multispectral image of KOMPSAT-2

2.2 Orientation Analysis

RPC and 22 GCPs obtained in field survey was used in the orientation analysis of KOMPSAT-2 images.

For GCP survey, GPS measurements were carried out by selecting 22 points in the overlapping area of stereo images. The Trimble-4700 and 4800 were used for Static DGPS. The GCP survey precision was within ±0.1m of both horizontal and vertical position. Figure 3 is the GCP distribution of the studied area.

The PCI Geomatica 10.1.3 was used as the module of orientation interpretations. Totally, eight experimental cases were put to the test including Point 1, 3, 5, 8, 10, 12 and 15 in addition to the Non GCP. The accuracy of orientation and check points was compared according to the utilization of GCP and the number of GCP.

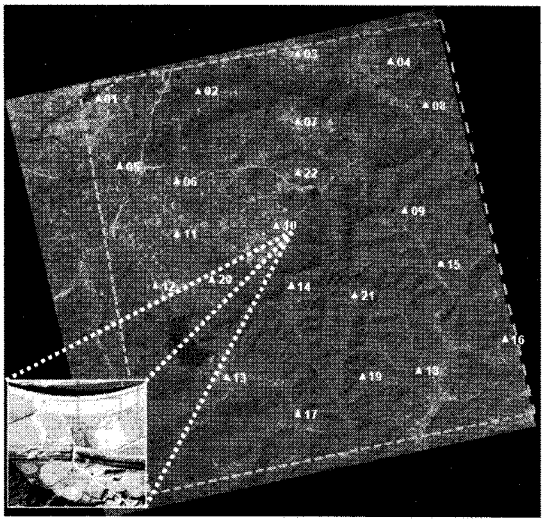

Figure 3. GCP distribution of the study area

Figure 4 shows the analysis results of orientation accuracy of each experimental case.

When orientation was implemented only with initial RPCs, the horizontal position error of the check points was ±43.52m. When using one GCP, the GCP observational error and the horizontal position error of the check points improved to ±6.77m and ±9.80m, respectively. As the number of GCP increased, the horizontal position error of GCP and check points gradually decreased. However, once the number of GCPs passed 10, the horizontal position error of the check points continuously decreased and the GCP observation error increased.

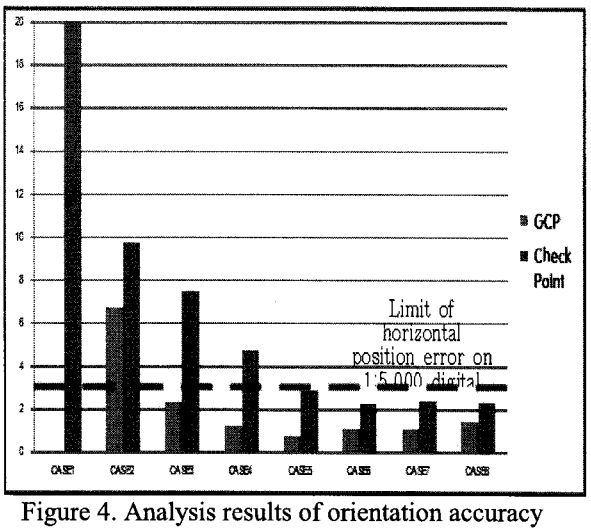

Figure 4. Analysis results of orientation accuracy

The GCP observational error was the smallest when using 8 GCPs. The horizontal position error of the check points was the smallest when using 10 GCPs.

In the study, 8 GCPs were used in orientation interpretation and in the generation of DEMs and orthoimage.

2.3 Generation of DEM and Orthoimage

DEM is a critical element to decide the accuracy of orthoimage and 3D geospatial information.

In the study, orientation interpretation was followed by the generation of a grid DEM(5m×5m) with epipolar images. For DEM interpolation algorithm, bilinear interpolation was used. Figure 5 presents the generated DEM.

In order to analyze the accuracy of the generated DEM, vertical error was analyzed according to such geographical features as hilly, flat, and mountain areas on a 1:5,000 digital map.

Table 2 shows the analysis results of the DEM accuracy. The results show that the DEM had higher elevation than the digital map in general.

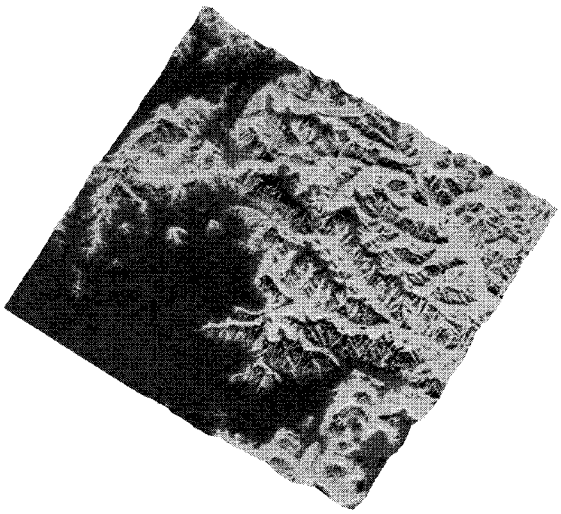

Figure 5. DEM generated from KOMPSAT-2 images

The vertical errors on flat, hilly and mountain areas are calculated as the average of 1.8m, 7.2m, and 11.9m, respectively. The parts with differences of ±5.0m or lower accounted for 58.18%, and those with ±5.0m~±15.0m accounted for 36.42%, and ±15.0m or higher accounted for 5.4% of the entire area, respectively. The differences of ±5.0m or higher are mostly observed in hilly and mountain areas. This observation may be caused by the absence of tree height revision. It is assumed that once the high trees are considered in the accuracy analysis, the differences between the DEM results and those from the digital map will be significantly decreased.

Table 2. Average error of the DEM according to geographical features

Number of GCPs	flat(m)	Hilly(m)	Mountain(m)
8	1.8	7.2	11.9

Differential rectification was carried out with the generated DEM to make orthoimage. Bilinear interpolation was used as the interpolation of image resampling, which was done with 4 pixel units.

Figure 6 shows the 1:5,000 digital map and orthoimage. There was an overall match in terms of mountain, road, agricultural land, and buildings.

In an attempt to analyze the accuracy of the orthoimage, 25 check points were chosen from the roads, buildings, and agricultural land in the study area. Also, The 1:5,000 digital map and horizontal position error were analyzed.

The results indicate that the horizontal position error of the orthoimage is ±3.1m, which is in the range of ±3.5m that is the permissible limits of horizontal position error on a 1:5,000 digital map.

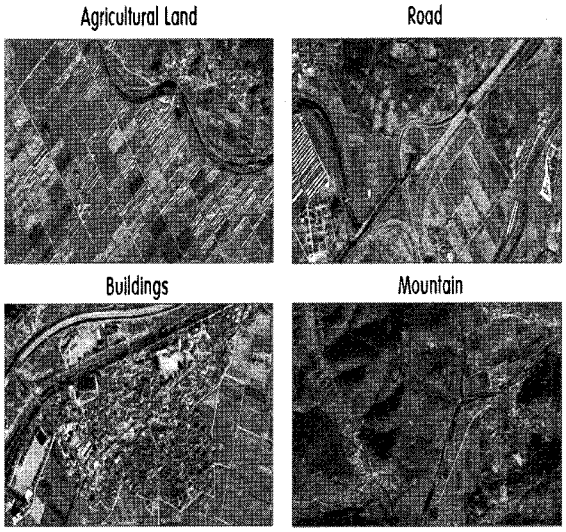

Figure 6. Orthoimage generated from KOMPSAT-2 images(parts of the study area)

3. CONCLUSION

DEMs and orthoimage were automatically generated in this study by using the stereo images of KOMPSAT-2.

The RPC block adjustment of KOMPSAT-2 images is the most suitable to use eight to ten GCPs.

It is possible to generate DEMs and orthoimage by using KOMPSAT-2 images. It is also proved necessary to correct the height of tree to obtain an accurate data of DEMs.

KOMPSAT-2 images can be used to generate geospatial information of small or middle scale greater than 1:5,000.

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