IMPROVEMENT OF ACCURACY IN THEMATIC INFORMATION USING AN OBJECT-BASED CLASSIFICATION

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ABSTRACT ... Object-based classification indicates a technique in which scale, color, shape, and texture are synthetically considered in order to segment objects and to extract information by consideration of characteristics of segmented objects, and its precision can depend on the results of object segmentation. In order to improve the precision of object-based classification, the author of this study conducted experiments applying multiple filtering in which image smoothing and edge detection were simultaneously used. Based on the results of land coverage information by multiple filtering, image division was conducted sufficiently better than with the original images, with fewer occurrences of incorrect classification.

KEY WORDS: Object-based classification, Filtering, High-resolution satellite images

1. INTRODUCTION

Because of a recent sudden increase in high-resolution satellite images at a level of 1m or less, the extraction technique of Thematic information has been changed from pixel-based classification to object-based classification.

Object-based classification divides objects by synthetic consideration of pixel-unit scale, color, shape and texture and extracts information by considering characteristics of segmented objects (Beuz et al., 2004; eCognition).

The precision of division in object-based classification may differ due to the results of object division. The object division requires an interrelation between adjacent pixels that can be estimated to be an object rather than extraction in which pixel information is used for each, and the final precision of the classification can be enhanced as the segmented pixel becomes more accurate.

As high-resolution satellite images are different in inter-pixel characteristics whereby even seemingly identical Thematics are recognized to be different ones, it is rather hard to conduct image division of them. In this study the author used image smoothing and edge detection filtering for image division to improve precision of Thematic information by using object-based classification.

2. EXTRACTION OF THEMATIC INFORMATION BY FILTERING

2.1 Study area and Data Characteristics

Yuseong-gu, Daejeon Metropolitan City, which is one of the city’s major downtown areas, is selected as the studied area. Especially, the areas with a river, building, or park are selected as the test fields to extract land cover information. KOMPSAT-2 images are used in the experiment after securing 1m-grade panchromatic image, 4m-grade multi-spectral stereo image, header information, and RCP data for the study area.

Table 1. Specification of KOMPSAT-2 images

<table>
<thead>
<tr>
<th>Category</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study Area</td>
<td>Yuseong-gu, Daejeon</td>
</tr>
<tr>
<td>Date of acquisition</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Row images</td>
<td>GSD 1m : PAN</td>
</tr>
<tr>
<td></td>
<td>GSD 4m : R. G. B. NIR</td>
</tr>
<tr>
<td>Level</td>
<td>1R(radial correction)</td>
</tr>
<tr>
<td>Stereo</td>
<td>stereo image</td>
</tr>
<tr>
<td>Image area</td>
<td>Left: about 253,050 km²</td>
</tr>
<tr>
<td>Overlap</td>
<td>Left : 94.2%</td>
</tr>
<tr>
<td></td>
<td>Right : 93.8%</td>
</tr>
<tr>
<td></td>
<td>Average : 94.0%</td>
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</tbody>
</table>
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 May 6, 2008 and April 12, 2009. The area of the left image is about 263,050 ha, and that of the right image is about 253,923 ha. The overlap is about 94%.

For the orientation analysis of the KOMPSAT-2 images, GCP and RPC information collected from a 1:1,000 digital map was used. The orientation analysis results are DX = ±1.49m, DY = ±1.09m, and DL = ±1.85m. They are better than ±2m, which is the absolute orientation accuracy of 1:5,000 digital map.

In the study, orientation analysis was followed by the generation of a grid DEM(5m×5m) with epipolar images. For DEM interpolation algorithm, bilinear interpolation was used. Figure 4 DEM generated from KOMPSAT-2 images.

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.

2.2 Methods of Experiment

Image filtering can be roughly segmented into image smoothing and edge detection. Because image division requires smoothing interrelations between adjacent pixels and clear extraction of edges of segmented objects, multiple filtering using both image smoothing and edge detection was applied.

Image smoothing used Median Filter and Lowpass Filter. While edge detection used Laplacian Filter and Highpass Filter. As for methods of experiment, 16 experimental cases by association of critical values of parameters of each filtering technique were selected, were applied to filtering, and were analyzed for precision by extracting thematic information from each image.

2.3 Results of Experiment

The precision analysis of Thematic information extracted from each experimental case was conducted qualitatively and quantitatively.

1) Qualitative Analysis

As for qualitative analysis, thematic information extracted as original images and positioning information was extracted from each experimental case.

Hydrosphere

The hydrosphere failed to show sufficient differences before and after filtering. The border of the hydrosphere after filtering was extracted as an orthopedic form against the border before filtering.

Forest

Before filtering, the forest was not easily extracted as an orthopedic form because of effects of adjacent grassland, vacant land, and shadow, but after filtering, could be extracted as an orthopedic form.

Grassland

As for grassland, a dark field was wrongly classified as forest before filtering, but after filtering, this incorrect classification was reduced.
Shadow
Because shadow was extracted from hydrosphere and forest, it was hard to classify shadow fields adjacent to a hydrosphere before filtering, but after filtering, shadows adjacent to hydrospheres and forest could be separated.

Roads and Urban Area
The results of Thematic information of roads after filtering showed an orthopedic form when compared to the images before filtering.

Raw Land
The Raw Land showed relatively similar classification results between before and after filtering.

Buildings
As buildings are classified by reference of LiDAR data, there was not a significant difference.

Based on the qualitative analysis, in general the Thematic information extracted after filtering was extracted orthogonally from form and borders when compared to that before filtering.

2) Quantitative Analysis
As for quantitative analysis, the amount of error based on size on the basis the Thematic information produced as digitizing by using the original images from the Thematic information was extracted from each experimental case.

The amount of error of the original images was 21.32% and that of experimental cases was between 8.72% and 16.22%, indicating that the amount of error was reduced in the latter.

The amount of error of the hydrosphere and buildings showed less of a difference between before and after filtering, while the forest, grassland, and vacant land were reduced in the amount of error after filtering.
3. CONCLUSION

The results of application of image smoothing and edge detection filtering in order to improve precision of Thematic information by using object-based classification were as follows.

First, the Thematic information extracted after filtering was orthopedically extracted from forms and borders when compared to that before filtering.

Second, the amount of error of the original images was 21.32% and that of experimental cases was between 8.72% and 16.22%, indicating that the amount of error was reduced after filtering.

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