LAND USE CHARACTERIZATION USING LANDCOVER OBJECTS FROM HIGH RESOLUTION SATELLITE IMAGE

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ABSTRACT:

High resolution satellite images such as IKONOS and Quick Bird data provide detail information of land cover at a certain point of time. The small objects in an image represent specific conditions of the land cover and the land use on the area. In this study, a semi automated algorithm and manual assisted algorithm as developed to generate land use map from IKONOS pan-sharpen image with a rule that understand land use from land cover objects, and re-construct land use categories from small land cover objects which were generated by image segmentation processing method. The average size of the image segmentation was changed from 1,000 pixels to 50 pixels, and the homogeneity of the image object was examined by visual interpretation. By some experimental operations, the variance level to identify an homogeneous land cover was define as 300-700 depend on the land cover type for the IKONOS image, and about 15,000 objects from the test site image, which consists of 1 million pixels, were extracted as land cover objects(segmentation). The land cover categories such as “deciduous forest”, “ever green forest”, “paddy filed” and some “orchard” with the variance level of 300 with 500 pixel size of image objects show homogeneous land cover type. And the land use categories such as “residential area” group show 500 of variance level with less than 200 pixel size show homogeneous unit of the land cover. About 100 types of land cover objects are classified by the supervise classification process, including unclassified objects.

1. INTRODUCTION

High resolution satellite images such as IKONOS and Quick Bird data provide detail information of land cover at a certain point of time. The small objects in an image represent specific conditions of the land cover and the land use on the area. For example, we are easily recognize the objects like roof of houses, road surface, water body in narrow stream and small pond, car on load and in parking and trees in garden and forest, in IKONOS image. It is possible to delineate some boundaries of land cover/use unit of land from the image by manual work even though we do not know the area at all, by over-viewing the area of the interest carefully. We should classify a tree in a garden as residential area instead of forest, however, it is difficult for computer software to classify the land use and land cover type by focusing only the small land cover object or a pixel. In this study, a semi automated algorithm and manual assisted algorithm as developed to generate land use map from IKONOS pan-sharpen image with a rule that understand land use from land cover objects, and re-construct land use categories from small land cover objects which were generated by image segmentation processing method. A software which produces image segmentations, was used to generate image objects by changing the size of the image objects. Generally, the smaller the segmentation size, the smaller the variance of the digital number values in the image segmentation. Furthermore, the spectral characteristics of the land cover type were examined base on the visual interpretation and statistical processing. According to our examination, about 100 types of land cover objects are classified by the supervise classification process, including unclassified objects. In order to make a rule that builds land use categories with land cover objects, existing land use digital map of 1/2,500 scale was use. Overlaying the land use digital map with the land objects image, the relation between a land use category and land cover objects was analyzed. For example, the land use object named “school” consists of the land cover objects of “tree”, “bare dry soil”, “concrete building”, “grass” and so on. There are 17 land use classes in the 1/2,500 scale land use map, and 1,200 land use objects in our test site on the existing land use map. In the study, about 400 land use objects were classified by our developed algorithm, and about 400 land use objects had required manual work assistance for adequate classification. The developed method was helpful to make high resolution land use map or revise the existing map, and the result map makes good showing compared with the pixel based classification map.

2. DATA AND SOFTWARE

The used data is IKONOS/Pan-Sharpen image with 1m spatial resolution. The test site is southern part of Kyoto city, Japan, where originally the agricultural land use were dominant, however, the urbanization is promoting due to the advantage of the location nearby mega-cities such as Osaka and Kyoto, and the socio-economical problem of Japanese agriculture system such as aging of farmers and lack of successors. Fig-1 show the study site and data with 1,000 pixels and 1,000 lines(1 million pixels). The area consists of agricultural land use such as paddy field and vegetable field including green houses, residential land, industrial land use covered by factories and storehouse, irrigation channels, roads, parking lots and railways.

In this study, an object oriented classification software named “Definiens Developer ver.7.0” was used for segmentation and producing object of land cover.

Figure-1 Study site

3. ANALYSIS

3.1 Image Segmentation

Image segmentations are produced by "Definiens" by using parameters listed in Table-1. Scale Parameter(SP) was set to 10, 30, 50, 100, 200 and 300 to make different size of image segmentations.Fig-2 shows the comparison of different size of object size, where SP is set to 50 in the left image, and 200 in the right image. There are 454 objects (segmentations) by setting 200 of SP, and 5639 objects by setting 50 of SP.

Scale Parameter	10,30,50,100,200,300
Shape	0.1
Compatchness	0.5
Algorithm	ulti resolution Segmentatio
Image Object Domain	pixel level

Table-1 Parameters for image segmentation

Figure-2 Segmentation
(Left :SP=200, Right: SP=50)

3.2 Area and Variance of Image Object

By calculating the area and variance of each image object generated by the software, The relationship between the two variables are analyzed.

The relationship between the two variances are similar for the four bands in the IKONOS Pan-sharpen image, however the variance for the Band4 is bigger than those of other three bands. So the variance for Band-4 is used to categorize the land cover type.

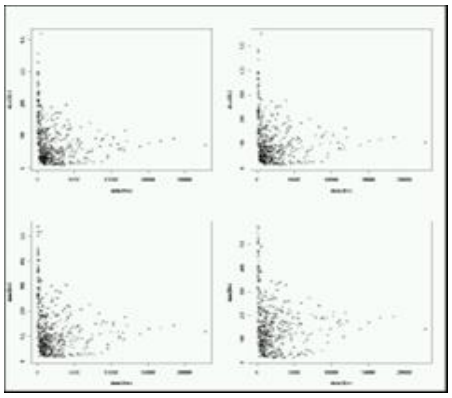

Figure-3 Relationship between area and variance of image object
(UR: Band-1, UL: Band-2, LR: Band-3, LL: Band-4)

3.3 Extract Objects from Image

By understanding the statistical characteristics of the object, some types of the land cover are extracted from the image.

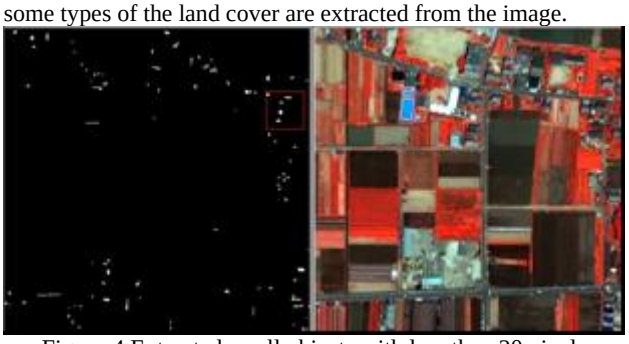

Figure-4 Extracted small objects with less than 20 pixels

Fig-4 shows the extracted small objects with the area less than 20 pixels. Most objects of less than 10 pixels are four-wheels motor cars on roads and parking lots, and most objects of from 10 to 20 pixels are roofs of smaller houses. No agricultural plots are included in this image.

4. DISCUSSION

Agricultural plots including paddy fields and vegetable open plots can be classified by the objects with the area more than 200 pixels and the band-4 variance less than 200. Industrial land use including big factories has larger objects with the area of more than 1000 pixels and high band-4 variance. On this stage of the study, each land cover class is not identified by the spectral characteristics, so that misclassification is not fixed yet. The classification algorithm will be modified by involving other land uses/covers such as forest and urban area with complex buildings.

5. REFERENCES

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