A STUDY ON THE ANALYSIS OF DAMAGE ESTIMATION USING AERIAL IMAGES FOR FUTURE KOMPSAT-3 APLLICATION

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ABSTRACT In this study we attempted to estimate damage scope such as bridges destruction, farmland deformation, forest damage, etc occurred by typhoon using two digital aerial images for future high-resolution Kompsat-3 applications. The process procedures are followings: First, image registration between time-different aerial images was implemented. In this process one image was geometrically corrected by image-to-image registration. Second, image classification was done according to 4 classes. Finally through the comparison of classified two images the area of damage by flood and storm was approximately calculated. These results showed that it is possible to estimate the damage scale relatively rapidly using high-resolution images.

KEY WORDS: Kopmsat-3, Classification, Damage Estimation, Aerial Images

1. INTRODUCTION

Very High Resolution (VHR) satellite images are potentially an attractive source of information for governmental decision makers especially in the case of emergency state. Imagery with a resolution of 1 m and less not only allows a detailed mapping of land-cover, but the acquisition of images at multiple dates also facilitates monitoring dynamic areas where rapid changes in land-cover occur. Also these very high-resolution multispectral satellites, such as Ikonos or Quickbird, provide a level of detail compatible with land-cover mapping, i.e. from 4 to 2.5 m spatial resolution. Multispectral sensors also have the advantage, over color aerial photographs, of recording reflected light in the near infrared domain. Near infrared is the most sensitive spectral domain used to map vegetation canopy properties (Guyot 1990) and may improve the discrimination of vegetation communities especially in rural areas.

Two main approaches can be taken to deal with the strong spectral-spatial variability in VHR imagery: image segmentation or classification processing. The former is applied before the classification process, and the latter after an image is classified. For the segmentation approach, the image is divided into regions of similar pixels prior to classification. These so called image segments do not necessarily have any cartographic meaning and can be considered as image primitives. Once they are created, they can be attributed to a land-cover class by any type of classifier. Many methods of image segmentation have been developed (Pal and Pal, 1993). The most common methods to segment a full image are: global thresholding (Sahoo *et al.*, 1988), region growing algorithms, watershed segmentation (Wegner *et al.*, 1997), and texture segmentation algorithms. The latter can be based on spatial frequencies (Hofmann *et al.*, 1998), Markov Random Field models (Panjwani and Healy, 1995), co-occurrence matrices (Haralick and Shapiro, 1985), Recently, multi-resolution image segmentation (Baatz and Schäpe, 2000) has received quite some attention as it is a part of the object oriented image classification approach embedded in the commercial software Defintions Professional®.

In this study for future kompsat-3 application, digital aerial images assumed relatively similar spatial resolution was used to estimate damage scope.

2. STUDY AREA, DATA AND METHODOLOGY

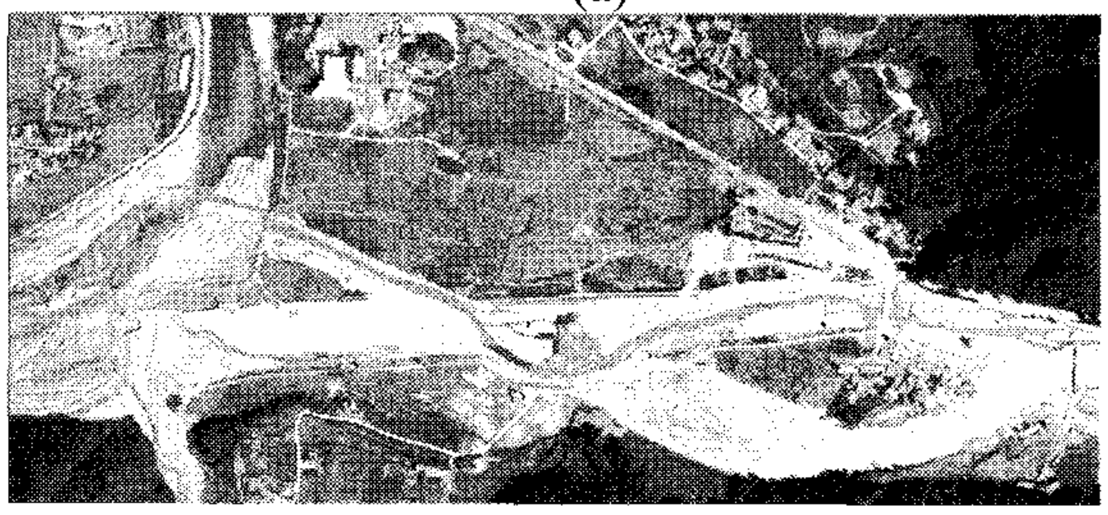
2.1 Study area

This study site, located in the north-east of Republic of Korea, corresponds to Kangwondo Inje-gun Buk-mun Hangeri town (128° 15' 10" Long E/ 38° 08' 17" Lat N). This region mainly is composed of forest areas, farm lands, water, road and minor urban features. Also this town experienced typhoon damage. From July 14th, 2006 to July 18th, 2006 severe rainfall occurred. (The average rainfall is 437mm during this period). The area of test site is approximately 1,352,018 m^2

2.2 Used data

At first this study aims at the estimation of damage area by disaster using future kompsat-3 satellite images assumed as higher spatial resolution than Ikonos or Quickbird satellite images. However, at this time, such high resolution satellite images are not available. So in this study two digital aerial images was used. The spatial resolution of black and white aerial image is 0.4233 m. The acquisition time is May, 2005. The spatial resolution of color aerial image is 0.3175 m. The acquisition time is September, 2005. The sever rainfall occurred in July, 2006. So black and white/color images were before and after images respectively in the event of severe rainfall. Figure 1 (a)-(b) showed the image of before and after rainfall.

(a)



(b)

Figure 1. Aerial images in study area

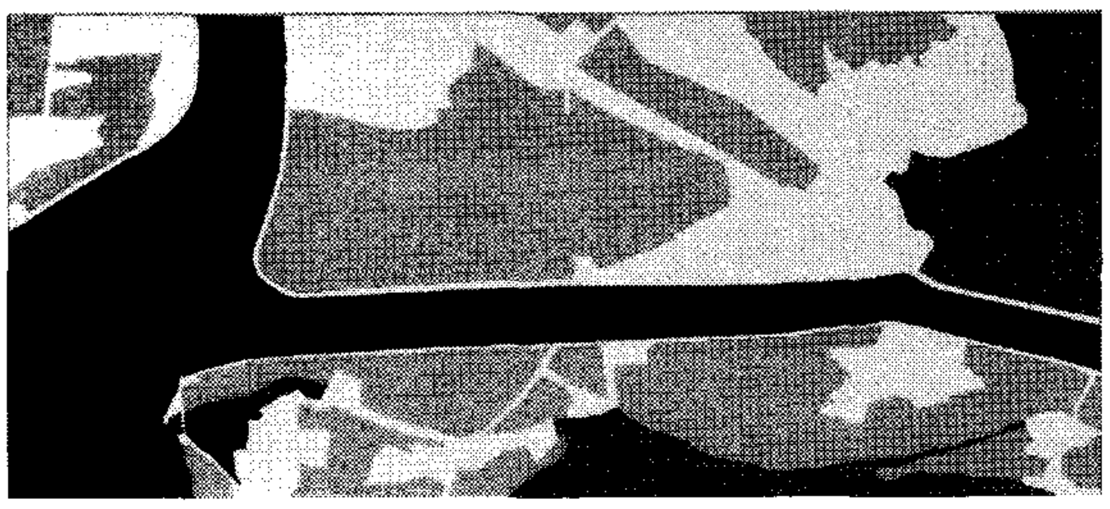
2.3 Methodology

2.3.1 Pre-processing In the first stage two aerial images must be registered. Digital color image was precisely geometrically corrected using photogrammetric method. For rapid implementation black and white aerial image was registered into color image using polynomial method and conjugate points. And for efficient calculation black and white image was interpolated at 0.3175 m-spacing , which corresponds to the resolution of color image during image registration.

2.3.2 Image classification For calculation of damage area occurred by sever rainfall in this study image classification method was used. Considering the land cover types 4 classes (forest, water body, farmland other urban-related land type) was defined. In the case of black and white image because only intensity data was used the results using segmentation and classification method was very poor. So manually 4 classes were extracted.

3. TEST RESULTS

The results of manual and supervised classification method are shown in Figure 2. In the figure 2-(a), farmland and forest areas are mainly occupied. And water body is relatively small region. In the figure2-(b), we can recognized the trace of damage after sever rainfall. In the center of image some parts of farmlands are swept away due to the heavy rainfall. Also more detail investigation could reveal the broken of embankment. Table 1 shows the results of the change of land–cover types. After rain fall the area of water body increased substantially. The change of forest and farmland relatively is low. However, after rainfall urban related features increased in a great measure. This phenomenon is mainly caused by poor classification especially in urban related features. In the process of classification of color images, only 3 bands can be available and spectral characteristics of farmland and forest are very similar in 3bands considering the seasonal factors. So the separation of these two types of land cover is very difficult.



(a)

(b)

Figure 2. Classification results : (a) Manually classified results in B&W image (b) classified results in color image

Table 1. The results of classification

size	Class	Color	B&W image	Color image
Width : 3106 Height : 1371	Forest		687830	795442
	Farmla-nd		1543318	1500714
	Water body		883681	1644163
	Urban-related features		1143497	318007
Total (pixels)			4258326	4258326

4. CONLCUSIONS

Information from remotely sensed images can play a useful role in understanding the nature of changes in land cover/use. Such information is essential for rapid decision making in the case of disaster. This study shows the possibility of recognition of damage scope and area.

Future study is necessary for precise classification method in very high spatial resolution image.

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