CASE STUDIES OF AUTOMATIC CHANGE DETECTION USING AVNIR-2 ONBOARD ALOS

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1. INTRODUCTION

Change detection using satellite imageries is useful in various situations such as land-use, land-cover, and damage analysis due to natural disasters. Recently, more detailed change detection is become possible by increasing of satellite imageries available for practical usage and improvement in their spatial resolution. However, a problem of visual change detection from high-resolution satellite imageries is to handle a large amount of information.

The purpose of this study is to develop a robust system of automatic change detection using multi-temporal satellite data. We firstly survey the pixel-based change detection techniques and consider their characteristics as well as problems. We then suggest a new change detection approach using the object-based contextual interpretation. In this paper, we describe results of case studies of change detection using the Advanced Visible and Near Infrared Radiometer type-2 (AVNIR-2) onboard the Advanced Land Observing Satellite (ALOS, "Daichi").

2. PIXEL-BASED CHANGE DETECTION

Many researchers have suggested various techniques of the pixel-based change detection using satellite imageries [1]-[3]. A simple system of automatic change detection for optical imageries was developed to implement the existing techniques and evaluate their results. This system needs to input geometrically aligned bi-temporal satellite images and implements following steps for each technique:

1. adjust global color tone of input images,
2. compare adjusted images and extract change indices in a way depending on each technique, and
3. evaluate change/no-change by statistical threshold of change indices.

As the case study of the pixel-based change detection, the system was applied for extracting mudslides damaged areas occurred by heavy rains on July 2009 in Yamaguchi city, Japan. Figure 1 (a) and (b) show bi-temporal AVNIR-2 imageries acquired before and after the disaster and figure 1 (c) shows one of the change detection results using these imageries. The results were found that there were no significant differences between the techniques. Consideration of them shows that the pixel-based change detection is capable to detect changed areas, however not capable to extract change information, such as type of damages that occurred by natural disasters.

3. CHANGE INFORMATION INFERENCE

The interpretations of image context are necessary to extract change information, and it will be improved total accuracy of automatic change detection. The object-based approach [4] is employed in our method to infer change information. Figure 2 shows the process chart of the method. This consists of three phases: image registration of bi- or multi-temporal images, detecting changed areas by pixel-based change detection, and inferring change information in detected areas. In inference, following steps are performed:

1. image objects are generated by image segmentation,
2. feature values of each image object are calculated, and
3. image context search based on knowledge of feature values and adjacency relationship of image objects is repeated.

Figure 3 shows an application result of our change detection method introducing the object-based approach in the same case with Fig. 1. Figure 3 (a) and (b) show the results of the object segmentations using (a) and (b) of Fig. 1, respectively. Figure 3 (c) shows result of extracting mudslides area by our method. The result clearly mentioned that the object-based image-context approach can work very well to reduce effects of noises into images, and be possible to extract changed area compared with the result of pixel-based approach as shown in Fig. 1 (c).

4. REFERENCES

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(a) Before disaster (June 14, 2009) (b) After disaster (July 30, 2009) (c) changed areas

Fig. 1. One of the pixel-based change detection results. Used data was observed by AVNIR-2 onboard ALOS in the case of heavy rains on July 2009 in Yamaguchi city, Japan

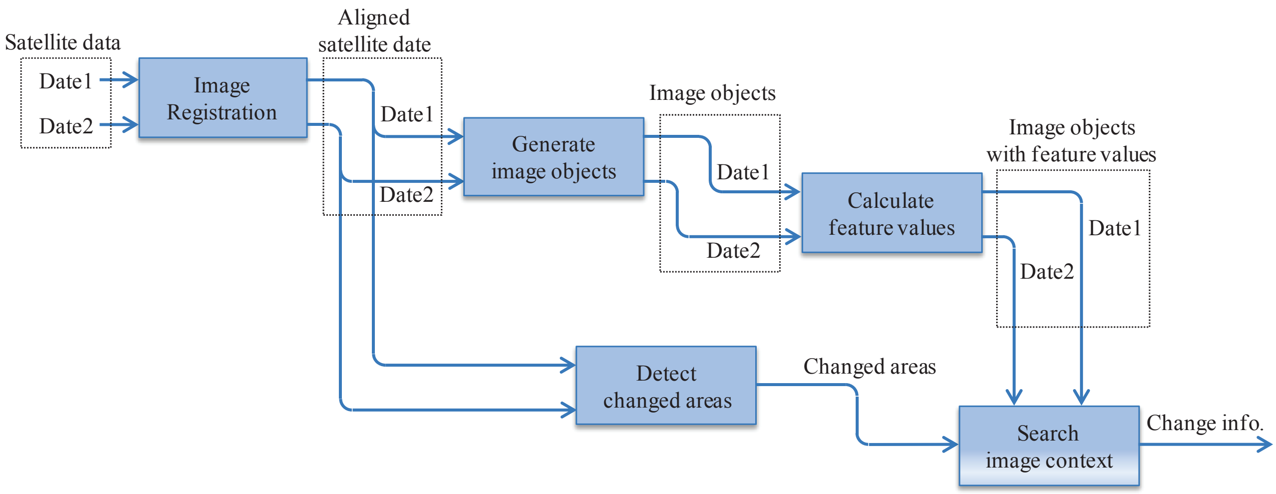
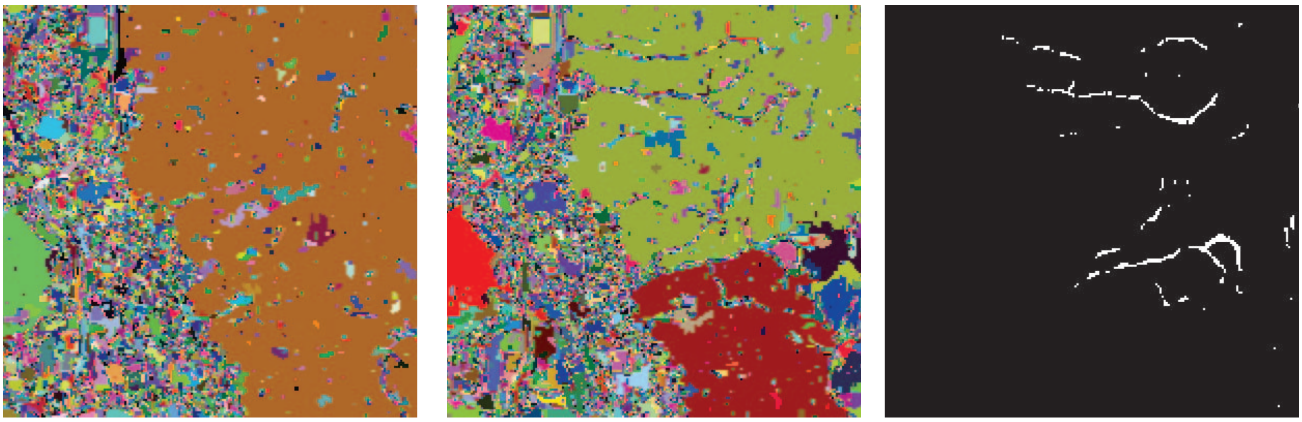


Fig. 2. The process chart of our change detection method using object-based contextual interpretation.



(a) Image objects of Fig.1(a) (b) Image objects of Fig.1(b) (c) Result of mudslide detection

Fig. 3. Mudslide detection result using our object-based image-context approach in the same case with Fig. 1.