

## AN EXPLORATORY STUDY ON THE DEVELOPMENT OF TECHNIQUE FOR IMAGE SEGMENTATION USING MOSAIC IMAGES

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**ABSTRACT:** Korea Aerospace Research Institute(KARI) fulfills various projects to support public sector users, who is represented by the Satellite Information Utilization Council, and provides mosaic images of the Korean Peninsula generated using KOMPSAT optical images every year to enhance user convenience. In addition, users of public organizations in Korea have shown constant demands for classified images. In response, we are trying to provide classified mosaic images to public users to improve the utilization of mosaic images so that users can easily apply mosaic images for their real work-site. However, there is a risk of obtaining inaccurate output due to distorted spectral information when performing classification with these images, as the mosaic images of the Korean Peninsula are pan-sharpened and color balanced images. Furthermore, the accuracy of the classification of mosaic images, which are provided with 1m spatial resolution, can be improved by applying object-based method rather than pixel-based method, as it can reduce the salt-and-pepper phenomenon. Therefore, in this study, we aimed to develop a technique to perform image segmentation minimizing the effect of spectral information so that any images including mosaic images could be segmented and classified even in an environment where the original spectral information was not available. Finally, it is expected that we can not only classify any images with lost or distorted spectral information, but also reduce the preprocessing stage significantly in the future.

### 1. INTRODUCTION

There are increasing demands for using satellite images between public users as the available satellite images are explosively proliferating these days with the development of small and cube/nano satellites constellations. Korea Aerospace Research Institute(KARI) fulfills various projects to support public sector users, who is represented by the Satellite Information Utilization Council, and provides mosaic images of the Korean Peninsula generated using KOMPSAT optical images every year to enhance user convenience. In addition, users of public organizations in Korea have shown constant demands for classified images. In response, we are trying to provide classified mosaic images to public users to improve the utilization of mosaic images so that users can easily apply mosaic images for their real work-site. However, there is a risk of obtaining inaccurate output due to distorted spectral information when performing classification with these images, as the mosaic images of the Korean Peninsula are pan-sharpened and color balanced images. Furthermore, the accuracy of the classification of mosaic images, which are provided with 1m spatial resolution, can be improved by applying object-based method rather than pixel-based method, as it can reduce the salt-and-pepper phenomenon.

Therefore, in this study, we aimed to develop a technique to perform image segmentation minimizing the effect of spectral information so that any images including mosaic images could be segmented and classified even in an environment where the original spectral information was not available.

## 2. METHODOLOGY AND DATA

### 2.1 Methodology

As the spatial resolution of satellite images are getting higher and more precise, traditional pixel-based methods are not accurate enough to classify these images. For instance, spectrally similar but compositionally different land cover may be misclassified and the spectral heterogeneity of the land cover can lead to rogue pixels creating a ‘salt and pepper’ effect (Whiteside and Ahmad, 2005). Thus, more and more researchers are using object-based methods to classify very high resolution satellite imagery which have usually higher than 1m spatial resolution.

The object-based methods require the segmentation process, which is the grouping of pixels into objects. And we tried to find out the optimal condition to segment mosaic images minimizing the effect of spectral information as those mosaic images contain only RGB bands which colors are modified.

Thus, we used eCognition Developer 9.4, which is one of the most robust tool to segment images (Meinel and Neubert, 2004), and adjusted 3 parameters, which are scale, shape and compactness, to figure out the optimal parameters for the segmentation of a mosaic image. Scale factor affects the size of each object while shape has compensated relationship with color, which means higher shape value represents high weight on shape and low weight on color. Similarly, compactness shows compensated relationship with smoothness.

### 2.2 Study area and data

Study area is Daegu city, S. Korea. It is located on the south-eastern part of Korean peninsula. We used a mosaic image which was created using KOMPSAT images acquired during the year of 2017. The spatial resolution of the mosaic image is 1m, and the number of the map system is 358062. The mosaic image contains RGB bands only, however, the spectral information of RGB bands was modified and somewhat distorted for pan-sharpening and color balancing. The area of the original image was about  $12.2\text{km} \times 14.67\text{km} = 178.9\text{km}^2$ , however, we clipped the image to the size of  $0.84\text{km} \times 0.83\text{km} = 0.698\text{km}^2$  to distinguish each object more easily. We also used 5m DEM as a reference data to generate the optimal segmentation parameters.



Figure 1. Study area

### 3. RESULTS

Following figures summarize the results.

#### 3.1 Scale factor: 100

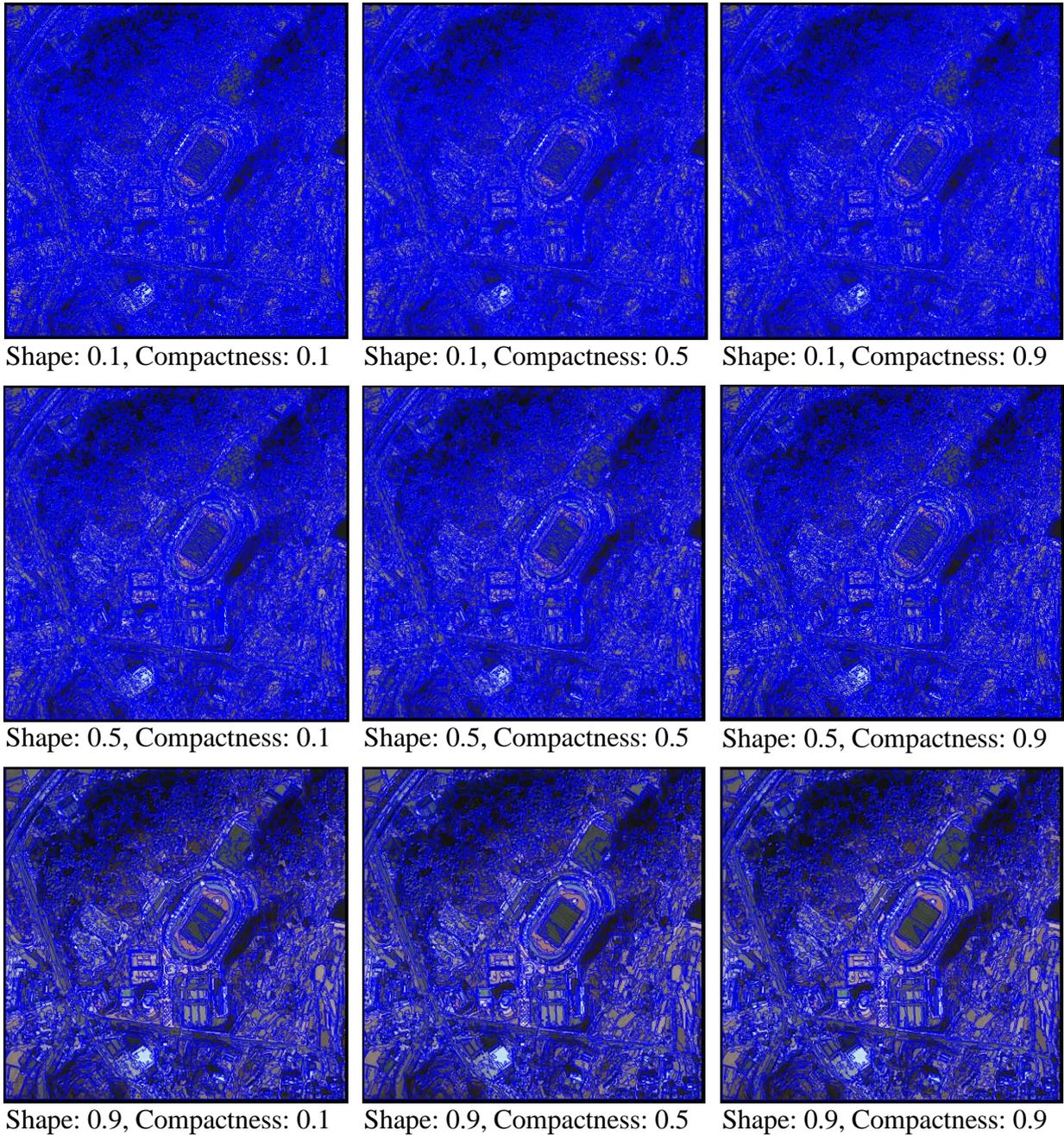


Figure 2. Segmentation results (Scale factor: 100)

According to the results, it is difficult to recognize each object because it is segmented too much at the shape factor 0.1 regardless of the compactness factor. In the scale factor 100 condition, 0.9 of shape value looks most feasible to segment this image.

### 3.2 Scale factor: 300

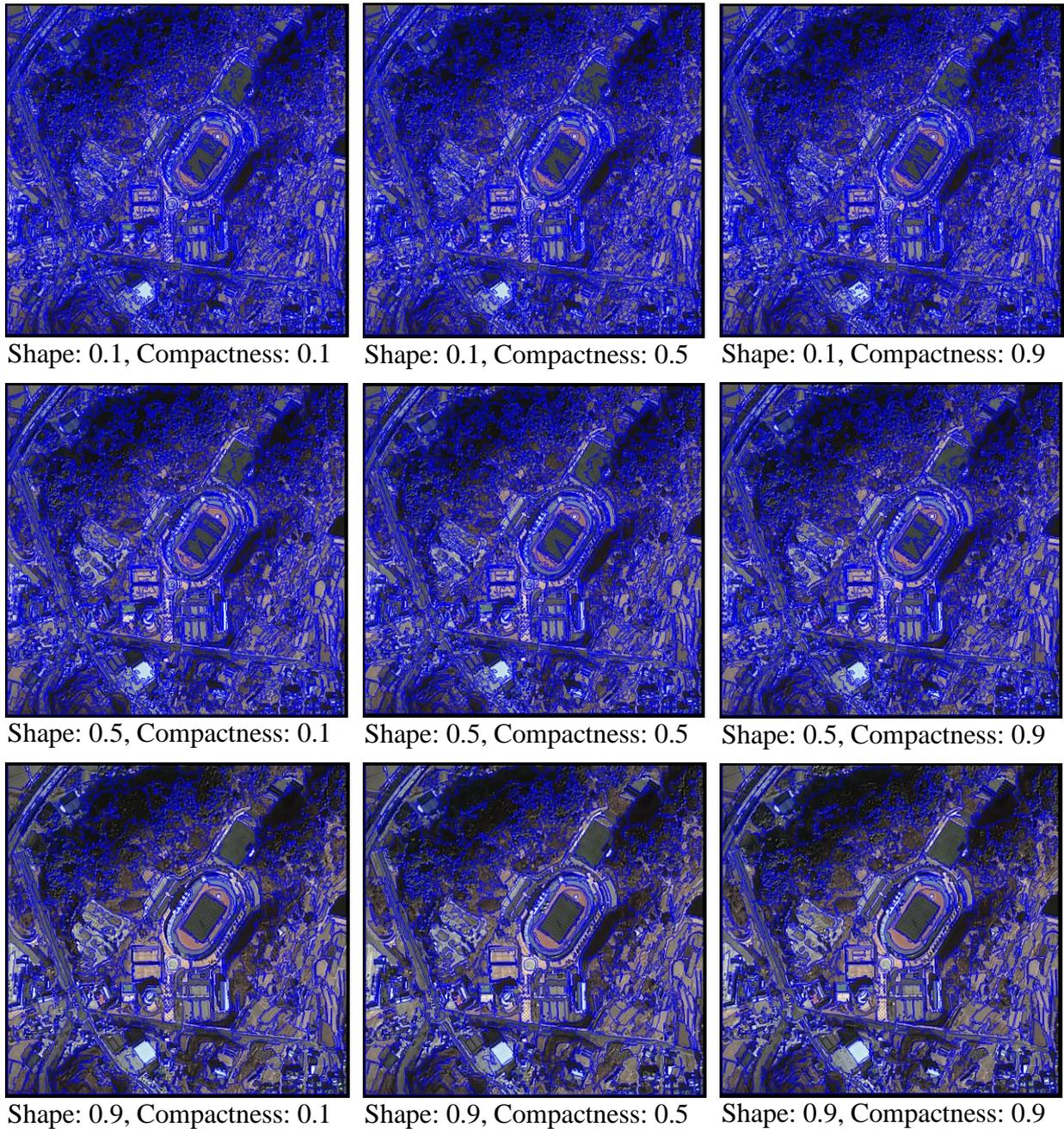


Figure 3. Segmentation results (Scale factor: 300)

With 300 of scale factor, the segmented images look more compact and simplified comparing the results of scale factor 100. However, 0.1 of shape value is still too much fragmented as each building is split into several objects. And this phenomenon is also found at shape value 0.5. In case of 0.9 of shape value, the grass of the stadium and buildings located at the bottom of the image seem quite uniform and are segmented as one object.

### 3.3 Scale factor: 500

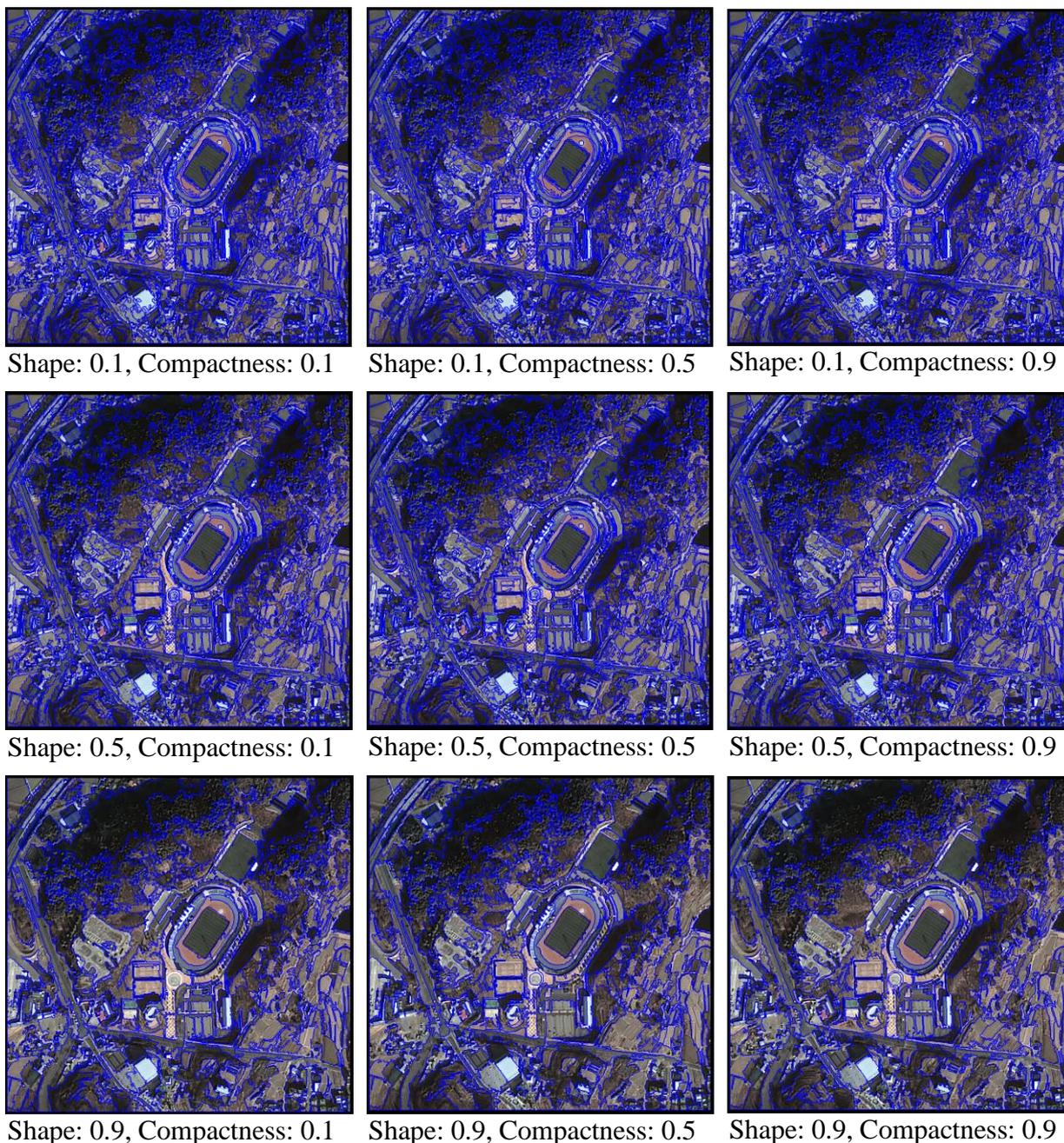


Figure 3. Segmentation results (Scale factor: 500)

In the condition of scale factor 500, all images are most simplified compared to the previous results. However, results from 0.9 of shape value show too much compact and merged results. Those images are not suitable for classification because many objects are mixed with neighboring features. Thus, shape value 0.5 looks most feasible for segmentation under the scale factor 500.

And it is also can be found that shape value has higher effect on the segmentation results compared to the compactness value. Thus, it implies that we need to take care and approach more sensitively when we modify shape value.

To sum up, considering results generated from different conditions, the results with scale factor 300 + shape value 0.9 and scale factor 500 + shape value 0.5 present the most suitable segmentation results.

#### **4. CONCLUSION**

In this study, we tried to find out the optimal segmentation condition for mosaic images minimizing the effect of spectral information. Summarizing the results of this research, segmentation results with scale factor 300 + shape value 0.9 and scale factor 500 + shape value 0.5 present the most suitable segmentation results. In addition, we also can found that shape value has higher effect on the segmentation results compared to the compactness value, which implies that we need to take care and approach more sensitively when we modify shape value. And further research is remaining for classification of mosaic images. Upadhyay et al., (2016) suggested algorithms to classify images using only RGB bands and succeeded to extract vegetation, water body, roads, and brown colored build-up area. However, we need to develop more sophisticated methods to extract land cover features because the RGB bands from mosaic images were color balanced losing original spectral information. Therefore, we need further research to classify mosaic images using the optimal segmentation parameters suggested on this study.

When we develop our research, it is expected that we can not only classify any images with lost or distorted spectral information, but also reduce the preprocessing stage significantly in the future.

#### **5. REFERENCES**

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