

USER BASED IMAGE SEGMENTATION FOR APPLICATION TO SATELLITE IMAGE

Hyuk Soon Im¹, Sang Sung Park², Young geun Shin², Dong Sik Jang²

¹⁾ Korea Aerospace Research Institute, 45 Eoeun-dong, Youseong-Gu, Daejeon, 305-333, Korea
dlagurtns@kari.re.kr,

²⁾ Division of Information Management Engineering, Korea University, 5 Anam-Dong, Seongbuk-Gu, Seoul
hanyul@korea.ac.kr, toctop@korea.ac.kr, jang@korea.ac.kr

ABSTRACT :

In this paper, we proposed a method extracting an object from background of the satellite image. The image segmentation techniques have been widely studied for the technology to segment image and to synthesis segment object with other images. Proposed algorithm is to perform the edge detection of a selected object using genetic algorithm. We segment region of object based on detection edge using watershed algorithm. We separated background and object in indefinite region using gradual region merge from segment object. And, we make GUI for the application of the proposed algorithm to various tests. To demonstrate the effectiveness of the proposed method, several analysis on the satellite images are performed.

KEY WORDS: Image, Segmentation, GA

1. INTRODUCTION

To meet the demand of various contents, image is developing to interactive multimedia service using satellite image. There are many studies working on abstracting significant object from satellite image, but they are not satisfactory so far. If end user can check the image object by subjective manual method, it can be led to satisfactory result. Recently there is suggested semi-automatic image segmentation method based on human knowledge to abstract significant image. This paper suggests new algorithm to segment satellite image by using gradual region-merging and gene algorithm.

2. PREEXISTING IMAGE SEGMENTATION

2.1 Preexisting image segmentation

Image segmentation has been done by two method so far. One is simple image classification by similarity. And the other is abstracting significant object from human sight system. There should be additional procedure to connect edge in image segmentation. And it should be execute to local segmentation in the image. But the edge detected when the border is not uncertain due to noise is the problem of image segmentation using edge.

2.2 User assistance

User assistance is to appoint the border of the image object with mouse that help to abstract more significant and exact object. User assistance can be done by several ways in window environment as followings - one is to draw square around the interesting area. Second, user draws the border of the object directly. And third, user makes spots on the border of the object to make a polygon. But they are time consuming and have accuracy problem to be proper methods. So in this paper, user uses

pen to draw the border and control the width as user wants.

2.3 Morphological image segmentation

The characteristic of morphological image segmentation is to separate the image that is satisfying similarity and continuance using shape, size, contrast and continuance of object in the image. Morphological image segmentation can be divided by simplification of image, inclination approach, and area decision. The purpose of simplification is to preserve the border of the area, to eliminate noise in the area and make the evenness of object area. Inclination approach maintains the shape of inclination to preserve the object in the simplified area to the bordered area as the object. Lastly, area decision separate the object or merging the area by using space similarity and topographical relation.

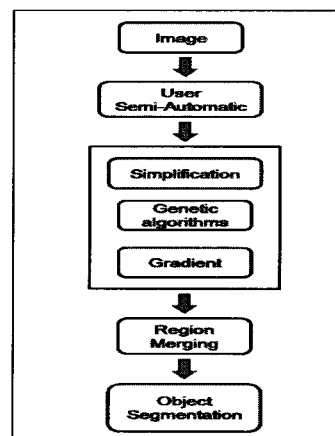


Figure 1. Image segmentation system

3. IMAGE SEGMENTATION ALGORITHM SUGGESTION

3.1 Image segmentation algorithm suggestion

Selected area is classified into border and background by gene algorithm that searches best edge by gradual area consolidation. (Figure 1) shows the structure of the suggested image segmentation.

3.2 object border method

To calculate the appointed border in the image, user should estimate whether it is included in the object or not by using pixel which is between internal border B_{in} and external border B_{out} of appointed area and classify the area. Pixel(p) is center value of the pixel that shows the border of the object and exists in the center of internal cluster $\{I_0, I_1, \dots, I_{n-1}\}$ and in the center of external cluster $\{O_0, O_1, \dots, O_{n-1}\}$. Each of internal vector I_i and external vector O_i is composed by five vectors (r, g, b, x, y) . (r, g, b) are color elements and (x, y) are coordinates of pixels. (Figure 2) shows how to classify pixels which are inside the area.

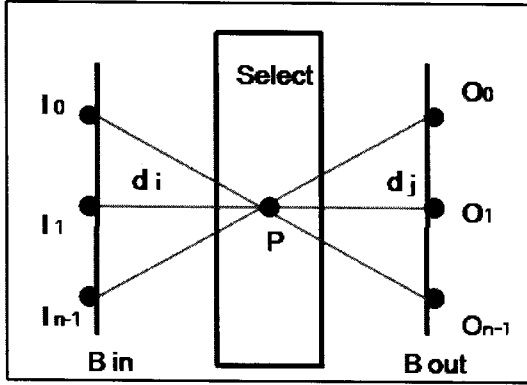


Figure 2. Pixel classification method of domain in, out

The following shows how to classify pixels between B_{in} and B_{out} to one of the internal area pixel of internal cluster or external area pixel of outer cluster. First, for each pixel(p) between B_{in} and B_{out} , distance to cluster center is calculated by (1) and (2).

$$d_i = w_{color} \times (|r-r_i| + |g-g_i| + |b-b_i|) + w_{coord} \times (|x-x_i| + |y-y_i|), \quad 0 \leq i \leq m \quad (1)$$

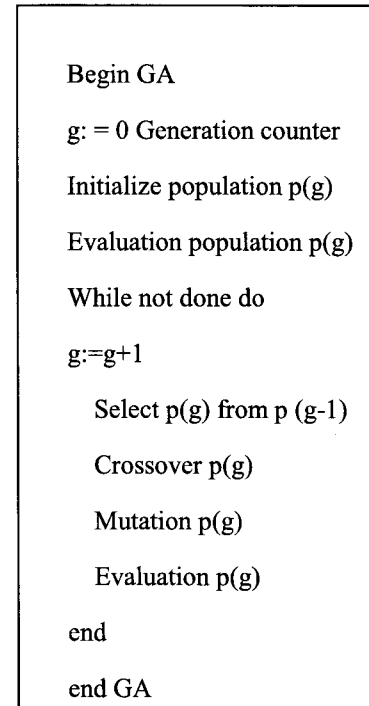
$$d_j = w_{color} \times (|r-r_j| + |g-g_j| + |b-b_j|) + w_{coord} \times (|x-x_j| + |y-y_j|), \quad 0 \leq j \leq n \quad (2)$$

W_{color} and W_{coord} are weight of the color and coordinate information. The sum of W_{color} and W_{coord} is 1. If pixel(p) is $d_i > d_j$, it is included in internal cluster, and if pixel is $d_i < d_j$, it is included in external

cluster. If picture element(p) is included in internal cluster, it is classified to pixel of object area and otherwise, it is classified to picture element of external area. Where picture elements of internal and external area meet becomes the border.

3.3 gene algorithm

Gene algorithm theory is modelling after the principle of the survival of the fittest of the nature ecosystem. This algorithm is looking for evaluation of optimized problem by searching all area. Each gene forms a population. Designated objects of one generation start from initial generation. Generations are set up randomly and the objects that were evaluated and selected by goodness of fitness function are evolved to be better in next generation by crossing and using mutation gene operator. Like this, it is to determine the time suitable for closing condition or to repeat to get result until it fits the standard. Gene algorithm structure can be found in (Algorithm 1).



Algorithm 1. Gene algorithms summary

In this paper, from selected width, gene algorithm is used to extract the border between in and out of the object area. Selection operator survives the objects that adapt well to the given environment and otherwise dismiss. RWS(Roulette Wheel Selection) used which is generally used selection operation. If the value of constant multiplied by standard error and average energy \bar{F} is subtracted from the whole energy value, it can express F' that is high energy value like (3).

$$F' = F - (\bar{F} - C \cdot \sigma) \quad (3)$$

Following (4) and (5) are formula for standard error and average energy each. N is the number of pixels correspondent to each area. As σ value get lesser, the area includes more similar pixels, it should be evolved to the direction that σ value diminishes.

$$\sigma = \sqrt{\frac{\sum_{i=0}^N (F_i - \bar{F})^2}{N-1}} \quad (4)$$

σ reduces the changing quality of energy F' to prevent early contraction and make smooth contraction. If energy value is less than 0, the value is becoming 0 and it is not allocated to next generation. \bar{F} is dispersed, data unit becomes different. So it is used to correspond to data unit.

$$\bar{F} = \frac{\sum_{i=0}^N F_i}{N-1} \quad (5)$$

New chromosome is generated by cross operator that generates child from parent. And two points are selected that two chromosomes are overlapped and exchanged to generate new chromosome. If two chromosomes are overlapped many, just dismiss the lower energy side. And if initial combination does not have proper evaluation, the coordinates(x,y) is moved and mutation operator is used to calculate the outline.

4. EXPERIMENT AND RESULT

It is developed in editing system environment based on objects for end-user to use easily. And working window is provided for user interference. Developed program can be divided into image view and image segmentation. In image segmentation module, image view is shown after all is operated. And test shows the result image of each stage operation.

	Edge extraction		
	Mask	Watershed	Region Merging
Satellite image 1	5 X 5	4322	4021
	7 X 7	3947	3532
	9 X 9	2677	2089
Satellite image 2	5 X 3	5443	5102
	7 X 7	5093	4823
	9 X 9	4754	3992

Table 1. Region number and merging number of experiment image

The results of the suggested method are compared in (Table 1). number of region and number of merging have

higher mask value due to noise elimination of the image, the numbers of region reduce.

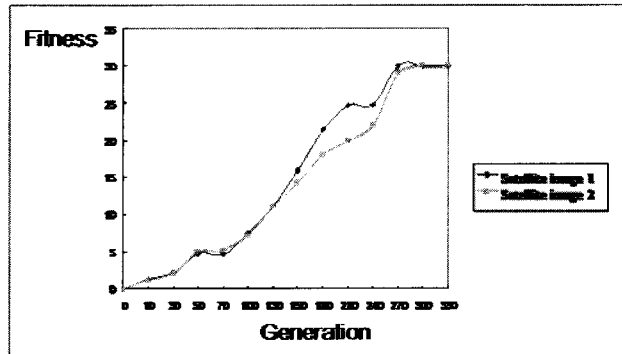
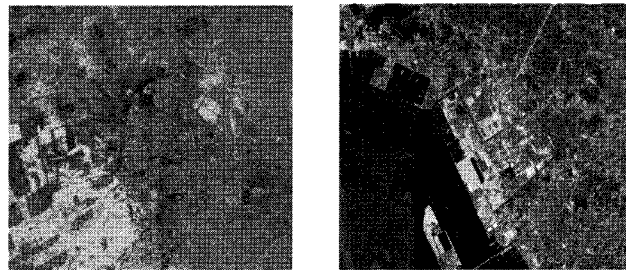
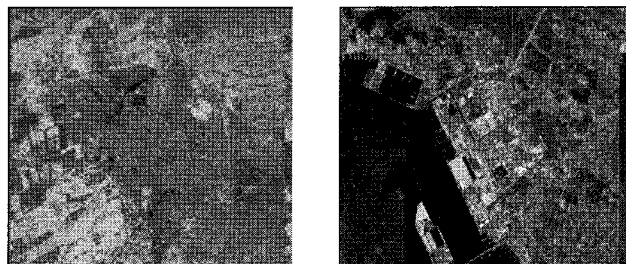


Figure 3. Result of GA iteration

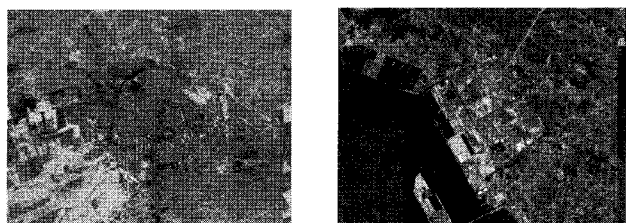
(Figure 3) Show the result of application gene. Reduction of the number of region does not mean good result, but it indicates consolidation was done with areas equalized. To segment more equally, suitable function should be advanced for good consolidation by controlling area consolidation set up. (Figure 4) Shows the result of image segmentation.



(a) Original image



(b) Region merging



(c) Image segmentation

Figure 4. Result of Image segmentation

5. CONCLUSION

Satellite image needs preparation elements that is indispensable for encoding based on object and interactive service. And due to difficulty of image segmentation, standard is not settled yet and satellite images related service which are provided now, are not encoded. To utilize in real service, whatever nature image should be segmented by auto or semi auto. But so far there is no satisfactory research result So, in this study, new algorithms is suggested that abstracts exact object from semi-automatic image segmentation. But there should be more study about operation time and effective abstract method from objects to put onto practice of satellite image segmentation. There can be foundation of practical use in service field after these image segmentation algorithm is competed in satisfactory level.

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