Segmentation by Contour Following Method with Directional Angle

Cheol-Hun Na* · Su-Yeong Kim* · Seong-Jun Kang*

*Mokpo National University

E-mail : chna@mokpo.ac.kr

ABSTRACT

This paper proposes the new method based on contour following method with directional angle to segment the cell into the nuclei. The object image was the Thyroid Gland cell image that was diagnosed as normal and abnormal(two types of abnormal : follicular neoplastic cell, and papillary neoplastic cell), respectively. The nuclei were successfully diagnosed as normal and abnormal. this paper, improved method of digital image analysis required in basic medical science for diagnosis of cells was proposed. The object image was the Thyroid Gland cell image with difference of chromatin patterns. To segment the cell nucleus from background, the region segmentation algorithm by edge tracing was proposed. And feature parameter was obtained from discrete Fourier transformation of image. After construct a feature sample group of each cells, experiment of discrimination was executed with any verification cells. As a result of experiment using features proposed in this paper, get a better segmentation rate(70-90%) than previously reported papers, and this method give shape to get objectivity and fixed quantity in diagnosis of cells. The methods described in this paper be used immediately for discrimination of neoplastic cells.

Index Terms

segmentation, discrimination, contour following method, directional angle.

I. Introduction

The Clinical Cytology which detects the cancer cells by analyze the microscopic images was introduced by Papanicolaou[1]. However, discriminations were achieved by human visual system. The digital process of medical image began early 1960' dealing with the microscopic images, X-ray images, and Computer Tomographic images. Digital image processing methods has been applied to Clinical Cytology[2]. But, the Clinical Cytology has many problems to the engineers. Medical features are difficult to understanding for engineer. And there are various features in every types of cells.

The Cytophotometric method discriminates the cell by measuring the DNA in the cells[2], but this method has a reliability problem because the DNA do not include the main feature of cells. In this paper, to overcome the limitation of above method. Nuclei are segmentated from medical cells image for discrimination by proposed contour following method with directional angle.

II. Segmentation by Contour Following method with directional Angle

1. Segmentation

Segmentation of an image entails the division or separation of the image into regions of similar attribute. The most basic attribute for segmentation is image amplitude of an image - luminance for a monochrome image and color components for a color image. Edges and texture of an image are also useful attributes for segmentation.

The definition of segmentation adopted in this chapter is deliberately restrictive because no contextual information is utilized in the segmentation. Furthermore, segmentation does

not involve classifying each segment. The segmentor only subdivides an image ; it does not attempt to recongnize the individual segments or their relationships to one another[3]. There is no generally accepted theory of image segmentation. As a consequence, no single standard method of image segmentation has emerged. Rather, there are a collection of ad hoc methods that have recieved some degree of popularity. Because the methods are ad hoc, it would be useful to have some means of assessing their performance. Haralick [4] have established the following qualitative guideline for a 'good' image segmentation : "Regions of an image segmentation should be uniform and homogeneous with respect to some characteristics such as gray level or texture. Region interiors should be simple and without many small holes. Adjacent regions of a segmentation should have significantly different values with respect to the characteristic on which they are uniform. Boundaries of each segment should be simple, not ragged, and must be spatially accurate." Unfortunately, no quantitative performance metric for image segmentation has been developed.

1) Contour Following Method

Successful image segmentation will end up with labeling of each pixel that lies within a specific distinct segment. One means of labeling is to append to each pixel of an image the label number or index of its segment. A more simple method is to specify the closed contour of each segment and append a label number to all pixels in contour.

Contour Following method[3] is explaned in Figure 1. A conceptual bug begins marching from the white background to the black pixel region indicated by the closed contour.

When the bug crosses into a black pixel, it makes a right turn and proceeds to the next pixel. If that pixel is black, the bug again turns right, and if the pixel is white, the bug turns left. The procedure continues until the bug returns to the starting point. The Cartesian coordinate of each black-to-white or white-to-black crossing is recorded as the boundary location.

In this paper, segmentation by the contour following method was carried out to classify the nucleus from background.

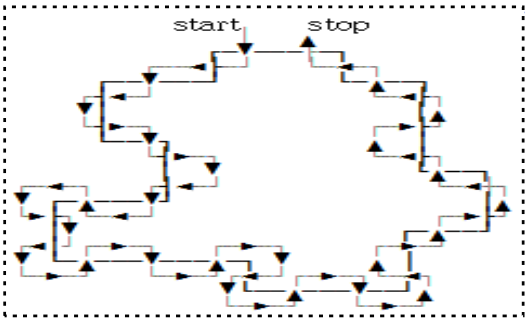


Figure 1. Example of Contour Following.

2) Proposed region segmentation method

The cells image contains nucleus, cytoplasm, red blood cell, and extra cellular materials : e.g., colloid, blood plasma. Thus segmentation for classification of the nucleus from cells image is required[2],[5]. In this paper, an improved method of region segmentation based upon Contour Following method is proposed. The Contour Following method in section b searches with two directions only. Searching by two directions is quite within the realms of possibility of missing the diagonal pixels. Thus, when the bug searches for the neighbor pixel, it should search for not only vertical or horizontal direction but also every other direction. A reasonable choice for the searching directions is directions with angle of multiples of . If the increment of searching direction for neighbor pixel, there is no missing pixel. Thus the proposed method settles the limitation of Contour Following method. Figure 2 shows the searching direction at each point.

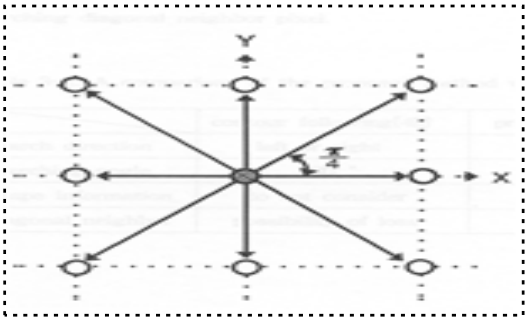
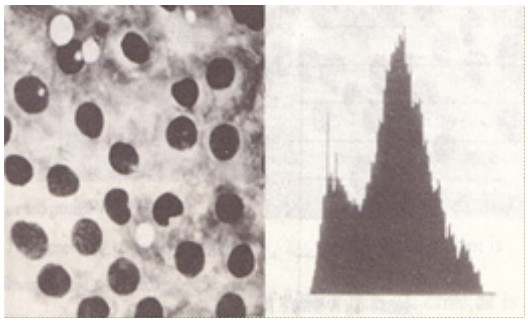


Figure 2. The searching direction at each point.

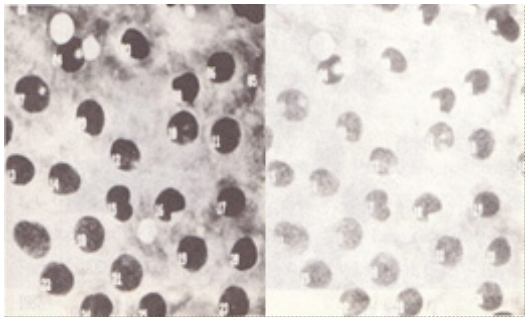
III. Experimental Results

At first, images are enlarged by microscope stored in computer memory. Then, the gray

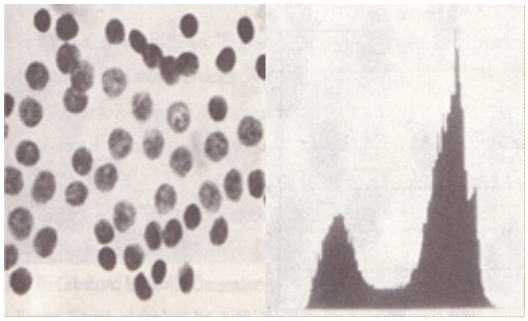
level histogram is calculated to select a threshold value. Then, classify the nucleus from background by applying proposed region segmentation algorithm to the thresholded image. Figure 3, 4 and 5 shows the result of experiment. Figures show that proposed algorithm do not lost the nucleus but the contour following method was lost some nicleus. The numbers in figures of (c) and (d) are the segmented nucleus number.



a) original image
b) gray level histogram

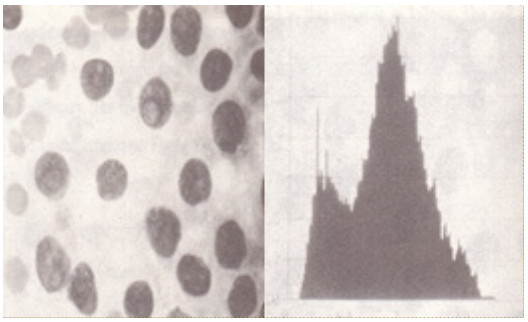


c) result by Contour Following
d) result by proposed
Figure 3. A sample result.

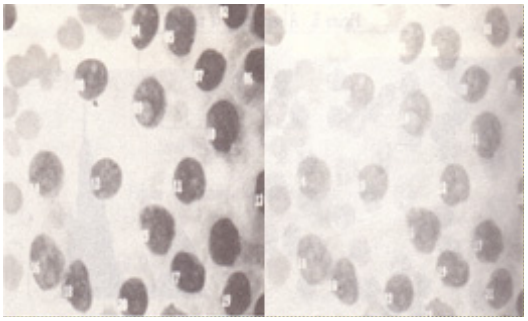


a) original image
b) gray level histogram

c) result by Contour Following
d) result by proposed
Figure 4. A sample result.



a) original image
b) gray level histogram



c) result by Contour Following
d) result by proposed
Figure 5. A sample result.

IV. Conclusion.

In this paper, a new method of segmentation of medical cells image was studied which using the pattern recognition techniques. The object cells image used in this paper was microscopic image of Thyroid Gland cells. As a result of experiment by proposed in this paper, following results were obtained.

The thresholding by variable mode method was

carried out for classifying the nucleus from medical cells image. As the result of thresholding by Mode method, nucleus was effectively classified from background.
The segmentation of the thresholded image into a isolated nuclei was carried out by contour following method with directional angle. The segmentation was very successfully executed.

With further study of discrimination of cells image considering the following problems. Separate the overapped nucleus, and using the various types of object.

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