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A Review of Cancer Cell Segmentation and Detection Usingnuclear-To-Cytoplasm Ratio Analysis

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Abstract- This paper presents a new progressive segmentation for cancer cells of third harmonic microscopic image. This method is based on detection of early diagnosis of cancer cells. The experimental result shows that the proposed algorithm gives Competitive results compared to the previous works deals with watershed transform. Basically biopsy means removal of invasive tissue from a living subject is a time consuming and complicated processes, so non invasive in vivo virtual biopsy, which possesses the ability to obtain exhaustive tissue images without removing tissues, is highly desired. Some sets of in vivo virtual biopsy images provided by healthy volunteers were processed by the proposed cell segmentation approach. This algorithm not only reveals high accuracy for cell segmentation but also has dramatic potential for non-invasive analysis of cell nuclear-to-cytoplasm ratio (NC ratio). The cell nuclear-to-cytoplasm ratios (NC ratios) of epidermis are generally larger in cancer than in normal cells This method indeed saves much time and provides convincing results with interpretation and discussion by medical doctors. Therefore, the method has significant potential for biomedical imaging analysis using MATLAB.

Keywords- Cell segmentation, Computer tomography, Graph-cut algorithm, Nuclear to Cytoplasm (NC) ratio, Red BloodCells, Third harmonic microscopy, White blood cells

I. INTRODUCTION

The early diagnosis of the skin cancer is detected by the physical biopsy procedure it involves the removal of the affected tissue from a living subject, and by using microscope it was evaluated [1]. This may lead to spread of the cancer cell to the healthy cells and also it is more painful to the patients also. Skin cancer is an abnormal tissue seen in the lower epidermal layers of the skin. This will affect the skin layer from the usual function. So the physical structure of the skin layer also changes. The matured stage of these abnormal tissue results in damage of the overall layer of the lower epidermis. The image modalities are the computed tomography (CT), magnetic resonance image; ultrasounds imaging these are the best examples of well developed technologies of visualizing the internal structures of in vivo. Its capable of only visualize smaller than 10-1m. These methodologies compare the current manual counting and method from the art and state

II. DATA EXTRACTION

A) Nuclear cytoplasmicratio (N/C ratio):

The ratio of nuclear to cytoplasmic mean fluorescence intensity. The ratio was normalized to 1 at time 0 (before stimulation).

B) Nuclear accumulation (NA):

The mean fluorescence intensity of a nucleus divided by the mean of the same nucleus at time 0 to be normalized for different protein expression levels between cells.

C) Nuclear increment (NI):

To acquire direct information on the speed of protein nuclear translocation, NI (ΔIi), was defined and normalizedas follows.

$$\Delta Ii = (Ii\_YFP(R) - Ii-1\_YFP(R))/I1\_YFP(R),\ i = 2,3,\ldots,n.$$

III. EVALUATION OF NUCLEAR SEGMENTATION

Three descriptors were defined- match, mismatch and false mask. A matched mask is defined by a nuclear mask which falls into the corresponding nucleus and covers more than 50% of the nuclear area (as detailed in the section of Segmentation). This definition includes an identified nucleus smaller than the real one, because we later proved that both s.d. and mean of the measured fluorescence of the target protein varied only slightly. If some area of a nuclear mask is out of the nucleus, e.g., overlapping with the cytoplasm, the mask is considered to be a mismatch. False mask denotes a nuclear mask caused by artifact fluorescence

IV. DIFFERENCE VARIATION

Different parameter settings for the erosion (*e*) and dilation (*d*) were tested and only those with maximal match between the masks and the corresponding regions were used to process the images. Even though the masks were all in the range of the corresponding nuclei or the cytoplasm, the measured values, NA or N/C ratio, were still different. Nonetheless, the more reliable descriptor should generate data with smaller variation. To evaluate the reliability, difference variation was defined and normalized as: $|Value\ 1 - Value\ 2|/(Value\ 1 + Value\ 2)$, where *Value* donates N/C ratio or NA, *1* and *2* represent data produced by two masks, respectively.

V. NC RATIO ANALYSIS

The calculation of NC ratio by proposed method follows the obtaining of the samples using virtual biopsy technique. The obtained image sample is allowed for high speed image segmentation. This segmentation involves two phases. Theyare separately labelled as follows:

- Nuclei Initialization

- Cytoplasm Segmentation

VI. NUCLEI INITIALIZATION

Nuclei segmentation is performed using graph cut method with marker-controlled strategy, blob detection, and consideration of shape descriptors to obtain accurate segmented nuclei. Nuclei segmentation is a crucial stage in the proposed cell segmentation algorithm because the subsequent stage of cytoplasm segmentation references valid nuclei, which can be thought of as the initial condition of the optimization problem of whole cell segmentation in order to guide the algorithm in finding a feasible solution with high performance.

VI. IMAGE SEGMENTATION BYGRAPHCUT METHOD

Image segmentation consists basically on partitioning an image into a set of disjoint (non-overlapping) and homogeneous regions which are supposed to correspond to image objects. When applying the graph cut method to the image gradient, the catchment basis theoretically correspond to the homogeneous gray level regions of the image. To determine the graph cut method used the image forest transform (IFT). The IFT defines a minimum-cost path forest in a graph, whose nodes are the image pixels and arcs are defined by an adjacency relation between pixels. The cost of a path in this graph is determined by an application specific path-cost function, which usually depends on local image properties along the path such as color, gradient and pixel position. For suitable path-cost functions, the IFT assigns one minimum-cost path from a given set of seed pixels to each pixel, in such a way that the union of those paths is an oriented forest, spanning the whole image.

VII.NUCLEI SEGMENTATIONALGORITHM

A) Nucleus Segmentation

Procedure:

- Function WBC NUCLEUS SEGMENTATION SCHEME
- Given an input image I
- Create a binary image, by thresholding
- Create a simplified image
- Compute erosion on I to discard small residues
- Compute the graph cut method using Ib as markers and Is to compute
- End function

For nucleus segmentation, use the graph cut by IFT, a general tool for the design of image processing operators based on connectivity. Since the shape of the WBC nucleus is extremely important in several further tasks, such as classification for differential counting purposes, use a path-cost function that takes into account suitable image characteristics.

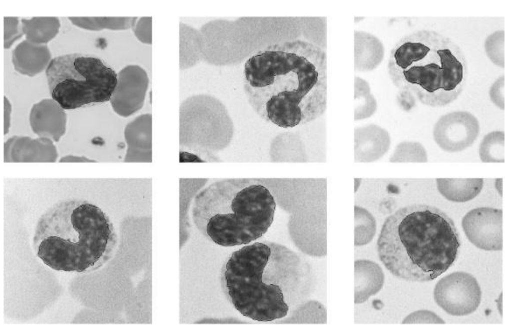


Figure 3.2:Nucleisegmentation

Note that some images contain noise, another factor that influences the quality of the gradient image. However, besides performing contour regularization, the simplification performed by the operator also filters the image, which makes this method robust to noise. Nucleus is accurately segmented for all the examples.

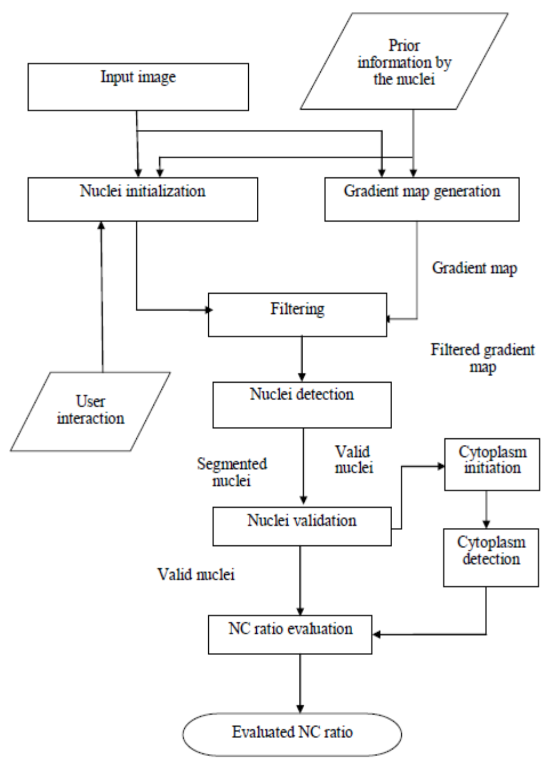
VII. CYTOPLASM SEGMENTATION

For cytoplasm segmentation, an index filter with intuitive parameter setting is adopted based on nuclei. Since it vectors instead of images, a convergence index filter is suitable for low-contrast and noisy microscopy images. Such a filter makes unnecessary the pre- to enhance contrast and remove irregular noise in biomedical images, while preserving the information needed for clinical diagnosis.

IX. CYTOPLASM SEGMENTATION

Procedure:

- Function wbc cytoplasm segmentation scheme
- Given an input image I;
- Compute the granulometric function to obtain the size distribution of the RBC,
- Create a binary image, Ib, using thresholding to separate background and objects
- Compute an opening on Ib with a structuring element of size
- Discard components that do not intersect with a previously segmented nucleus.
- End function



Block diagram of cell segmentation and NC ratio analysis

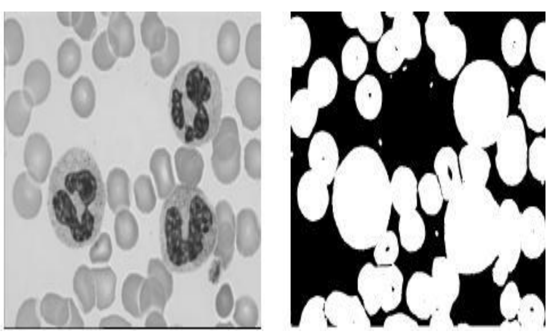
In addition, parameter setting for convergence index filter is intuitive for user or medical staff to adjust easily without technical details of algorithmic processing according to some fundamental information of input biomedical images to be analyzed like size or shape of cells. One thing worth mentioning is that convergence index filters consider contextual and locality information to have confident segmentation results and reduce uncertainty of segmentation resulting from low contrast and noise in images.The assumptions above enable information about valid nuclei to be used to detect size and shape of cytoplasm for each cell. Fig.5.1 shows an example of this idea. It depicts two adjacent cells whose convex regions contain their boundaries of cytoplasm in black and nuclei in red. Green arrows represent the distribution of gradient vectors around cytoplasm bound- Aries that point toward the corresponding cell center.

X. CYTOPLASM INITIALIZATION

First, the two constraints min and max distance from inner and outer boundary from the centre of the support region on each orientation has to be determined respectively. These two constraints are adaptive to the shape and position of each valid nucleus.

XI. CYTOPLASMDETECTION

After defining and for each cell, the support region of the proposed local filter can be thought of as the union of N line segments which represent cytoplasm width radiating from cell centre on each orientation in Fig.5.1. In addition, the definition of the convergence index of the gradient vector is almost the same as that of the sliding band filter but some constraints about variable distance between cell centre and the outer boundary of the support region on each orientation are different. .



(a)original (b)threshold

The proposed computer aided cell segmentation not only speeds the analysis of medical images but also provides objective segmentation results with consistent accuracy. On the contrary, conventional cell segmentation by manual selection of cells takes several minutes to segment and analyze one image and may suffer from fatigue of human skin and subjective judgments by medical staff resulting in poor results. The proposed method provides convincing results with interpretation and discussion by medical doctors. Therefore, the method has significant potential for biomedical imaging analysis.

XII. RESULTS AND DISCUSSION

By using the proposed method a 15bit of the binary images are 512*512 pixel image took 10-5 seconds. It also usable in the photo and video editing. The key aspiration is to offer the concept of object mining. In the field of medical imaging we acquire a 3D medicinal dimension. The corrections in these are performed with in a several second. These proposed algorithm increases the pace of scrutiny of medical images it not only provide scrutiny of images it also afford the segmentation results with a unvarying accuracy. In the manual assortment the segmentation outcome takes quite a few minutes and also it provides extremely deprived result.The proposed exertion hoards time and provides a convincing result with the construal and discussion by the medical doctors. Therefore the method has significant potential for biomedical imaging analysis.

Table 1 : Comparison with Previous Method

Measure	Proposed method	Existing method
Mean	1.2166	0.3100
Standard deviation	0.0813	0.0140
Time take to process	10-5seconds per image	Several minutes pre image

Table 2: Cell Segmentation Outline

Cellindex	**Nucleiarea**	**Cytoplasm area**	**Ratio**
1	48	233	1.1957
2	38	275	1.1300
3	26	90	1.2609
4	29	79	1.3333
5	25	97	1.2323
6	26	335	1.0712
7	33	171	1.1792
8	41	116	1.3305
9	26	115	1.2051
10	28	112	1.2281
Total	320	1623	-

CONCLUSION

The computer - aided design for automatic cell segmentation and NC ratio analysis was proposed. The experimental results show that the proposed method provides objective segmentation results with high efficiency and consistent accuracy. In addition, the evaluated NC ratio values are very close to the results of manual cell selection, indicating that the proposed work considering not only the performance of analysis procedure but also practical criteria as well as clinical requirement has significant potential for biomedical imaging analysis and medical values in a variety of applications. For example, it can help medical doctors to noninvasively and immediately identify early symptoms of diseases, especially fatal diseases like cancer, that involve abnormal NC ratios. Moreover, the determination of NC ratios of skin cells using the proposed automatic algorithm is more objective and robust than that using manual approach, and hence medical doctors can diagnose potential diseases without the influence of any subjective factor, such as the subjective judgment of analyzer and the fatigue of the medical personnel. It can also quantify several physical factors correlated with NC ratios or cell size, such as skin aging. This method may be useful for international cosmetics companies that assess and examine how a given product may affect the cells of potential users.

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