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Hybrid Segmentation Algorithm using M-F based Optimization Model and Modified Fuzzy Clustering

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Abstract— **In this paper, we propose and present an algorithm for medical image segmentation (MIS). By analyzing the current state-of-the-art related algorithms, we introduce the multi-band active contour model based limit function to make the multilayer segmentation available. With the development of image segmentation technology, the development of medical image segmentation technology also got very big, because there is no find common, accepted effect ideal is suitable for medical image segmentation method, almost existing each kind of segmentation method has application in the field of medical image segmentation. Further, with the optimized aims of being robust to the noise and avoiding the bad effluence on the result, we adopt the kernel method and new initialization curve. This model suffers from low noise robustness, and model algorithm is difficult to achieve. Integrated segmentation technology refers to two or more technology is used, combined with their own advantages, so they can on the accuracy or efficiency to as the robustness and effectiveness a concerned, our method is better than the existing medical image segmentation algorithms. Experiment analysis verifies the success of our method.**

Keywords— **Medical Image Segmentation (MIS), Kernel Function, Modified Fuzzy Clustering, Multi-band Active Contour Model, Optimization Model.**

I. INTRODUCTION

Medical image segmentation is becoming a hot topic in recent years. With continuous effort, researchers have proposed many image segmentation methods. However, many image segmentation problems remains unresolved, including the isolation method of low accuracy, high complexity, low robustness, and there is no universal method. Medical imaging due to the complexity of organizational structure, various organs of irregular shape and differences between individual factors, such as unclear itself is so general complex composition, texture, difficult to image segmentation. Plus noise is inevitable in the process of image capture, local effect, field offset effect which make with general image segmentation method for medical image processing effect is not ideal, the medical image segmentation become a challenging research direction in the field of image processing. These problems make the research on image processing, image segmentation of an open question. The existing image segmentation methods can be divided into the following classes. With the development of image segmentation technology, the development of medical image segmentation technology also got very big, because there is no find common, accepted effect ideal is suitable for medical image segmentation method, almost existing each kind of segmentation method has application in the field of medical image segmentation. Segmentation and integration technology, fuzzy segmentation, the segmentation technology based on knowledge and segmentation based on artificial neural network technology will be the development direction of medical image segmentation technology in the future. In this paper, an improved image segmentation method based on partial differential equations and the application of medical image segmentation is proposed.

Medical image of the active contour and adaptive contour map model [1] and multi-channel high computing efficiency and the advantage of the initial curve do not affect the segmentation result. This model can also provide more image data for the doctor, is applied to the analysis of the patient's condition. This model suffers from low noise robustness, and model algorithm is difficult to achieve. Integrated segmentation technology refers to two or more technology is used, combined with their own advantages, so they can on the accuracy or efficiency to achieve better performance than when using a single. Medical image is more complex, often in different regions have their own different characteristics, combine multiple technologies to form a new segmentation method is easier to obtain better segmentation effect. This will be an important research direction in the field of medical image segmentation. RSF differential model [2] with weighted local entropy takes full advantage of image intensity and local information, which results in more accurate segmentation in medical images. Fuzzy segmentation technique in the neighborhood of the medical image segmentation is the result of medical image itself with a lot of uncertain information. And fuzzy technology to deal with uncertain information has a good effect. This model is robust to noise and less sensitive to the initialization of level-set. To design a novel level-set based image segmentation method to overcome the defect of the aforementioned methods, we get the ideas from some research papers [3-17]. A multi-band Local Binary Fitting segmentation model [18] for medical images is proposed, which is an improved model based on RSF model and LCV model [18]. The segmentation technology based on knowledge application in the field of medical image segmentation is an important development t end. In the process of segmentation algorithm is improved, in considering the medical knowledge algorithm can get better

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effect. Useful medical knowledge including medical knowledge, such s the position of the symptoms of the disease, and will happen; the different features of imaging mode; the shape of the tissues and organs, anatomical structure, and general grayscale distribution, etc. Segmentation based on artificial neural network technology is obtained by training multilayer perceptron to the basic idea is linear decision function, and then classifying pixels using decision function to achieve the goal of segmentation. Medical image segmentation is according to certain rules of the area of medical image is divided into a few meaningful and adhere to the principle of consistency in every area. Image segmentation technology made it possible to medical image visualization, with the help of image segmentation technology, medical imaging classification effectively, and can provide essential diagnostic basis was provided for the clinical diagnosis and treatment, improve the real-time and accuracy of the diagnosis and treatment.

Artificial neural network technology was applied to medical image segmentation can be achieved better effect. We name the model to be the M-L model. Compared with WRSF model, LCV model has less impact factor and strength performance is better, but the level set of initialization will influence the results. For this purpose, the active contour model for regional restriction function and adaptive contour map and multi-channel multi-layer image segmentation algorithm and gauss curve function is used to improve the robustness of our model noise. Initializes a new curve is used to avoid the adverse outflow segmentation results and the introduction of the new penalty term liquid phase epitaxy Li to improve numerical stability and increase the step length to improve efficiency. Finally, get the better performance in image segmentation, a new method is also easy to use and spread. In the end, we conduct the experimental analysis with MATLAB. By comparing with the other methods, we draw the conclusion that our method holds the following advantages: (1) we use the novel border control function to control the level-set function's speed; (2) we adopt a novel penalty function to introduce the function of regional limit to achieve the goal pf multi-layer segmentation.

II. THE ESTABLISHMENT OF THE PROPOSED MODEL

A. The Definition of Proposed Model and Prototype

The represents the image, curve C act as the zero level-set curve of the level-set function $\phi:\Omega \to R$, the following formula is the definition. Based on threshold image segmentation method is simple, small amount of calculation, the characteristics of high stability, is the most basic method, is widely used.

$$\begin{cases} inside(C) = w_{k+1} = \{x \in w_k : \phi(x) < 0\} \\ outside(C) = w_{k+1} = \{x \in w_k : \phi(x) \geq 0\} \end{cases}$$

Gray image pixel gray discontinuity and similarity of these two characteristics at the same time, the gray image segmentation is generally determined according to these two features. Boundary pixel gray value in the image area can produce jumping which has no continuity, and regional internal pixel has similarity. Then on the basis of regional pixel gray discontinuity produced a series of image segmentation method based on edge detection, based on the similarity of pixel gray level in the area of produced a series of image segmentation method based on region. Image segmentation algorithm based on region is first rules for the image into several blocks, and then establish a specific attributes, based on the principle of attribute consistent, from the rule of excluding attributes is consistent, merge using window operation, the use of the operation of the pixel gray value within the
Figure 1

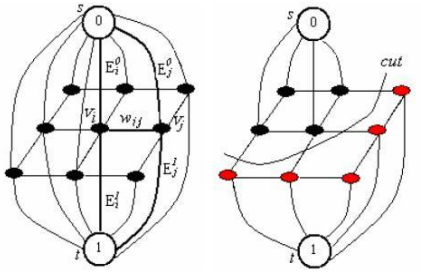

Figure 1: The Multiple Segment Organization and Topology

In the proposed model, From setting threshold means we can put the threshold segmentation methods are divided into two categories: one is artificial selection of threshold, a kind of automatic threshold choice is. Artificial selection combined with subjective visual perception threshold refers to the people through according to the picture observation and the histogram, can choose a accurate segmentation threshold of the image, generally in the middle part of the trough of the histogram threshold value or trough near the border of larger peak, repeatedly until the segmentation area edge smooth, completely separated from the target and background or goals and targets.

$$W_{k+1} = w_k - w_{k+1} \tag{2}$$

We can put the number of setting the threshold value from threshold segmentation method is divided into single threshold segmentation and threshold segmentation. As the image background and target gray value gap is larger, the gray histogram of the image will appear bimodal phenomenon, has obvious two peak valley, we take the valley's intermediate point as segmentation threshold, can obtain a good segmentation effect. This method targeted strong, application is very restrictive, gray were similar to background and target image is not applicable, not a good segmentation. Single threshold segmentation refers to in the process of image segmentation we only set a threshold, the image is divided into directly to the target and the background and threshold segmentation is to use multiple threshold divided into multiple target region and background from the image which can be expressed as the formula 3.

$$M^k(x) = H\left(-\phi^k(x)\right) + H\left(\phi^k(x)\right) \tag{3}$$

Based on threshold image segmentation is a widely used

segmentation technology, using the gray scale characteristics of target and background difference segmentation, simple implementation, but also can compress the data, reduce the image storage space, but closely linked to threshold segmentation and image grayscale histogram, the image histogram has certain requirements, make its application with limitations. For complex medical imaging, if only by using threshold segmentation is short of the ideal segmentation results. It can be formulated as:

$$(x)= H(x) \quad 1 \quad \varepsilon$$
$$' \quad = \quad (4)$$
$$\pi \quad +$$
$$\varepsilon \quad {}_2 x \quad {}_2$$

$\delta 1,\varepsilon(x)$ represents Edges in the image pixel gray value of discontinuity or mutation of area, is an essential part of the image, is an important attribute of the image characteristics, contains a lot of information, has an important role in image segmentation. Edge detection is mainly about the detection of image gray level change ϕ

$$\phi^{k+1} = argmin\ E(f_1, f_2, d_1, d_2 \quad ,\phi;\phi^{k}) \quad (5)$$

When the minimizer ϕ is the same as initial v lue 0 , Due to gray scale image edge discontinuity or mutate, so if a pixel is located n the border of the image and its neighborhood usually result in a change to a grayzone, this change has the gray level change rate and direction of these two features, gray level change rate can be expressed with the size of the gradient vector, gray level change direction can be represented with the direction of the gradient vector. Edge detection based on differential operator of gray level change within each pixel neighborhood was quantified and determine the direction of this change. The classical edge detection method using differential operator to extract the image edge, inspects each pixel in the image in the neighborhood, the variance of the use of the changing rule of the first or the second order directional derivative edge detection. The formula 6 define the model:

$$E = (1-\omega)E^{local} + \omega E^{globad} + vL_g(\phi) + \mu P(\phi)$$

III. EXPERIMENTAL ANALYSIS

Above M-L model is applied and the result is analyzed. Testing images can be divided into two categories: man-made images and real images. Real images are mainly x-ray images and MRI images. A PC with 2.13GHz CPU, 4GB RAM, Windows 7 operating system and MATLAB R2013a is used in the experiments. In most cases, only on the basis of gray difference for object segmentation algorithm is not enough, they can also be reflected in the differences in other statistical parameters of gray-scale image derived. Therefore can be composed of image gray scale, texture and other parameters of the multi-dimensional clustering analysis in the feature space. Clustering method is when the pixel mapping according to certain rules are divided into several regions after the feature space, if a pixel belongs to a certain area, has the gray level image pixel is belong to the class. In the following figures, we show the related experimental result.

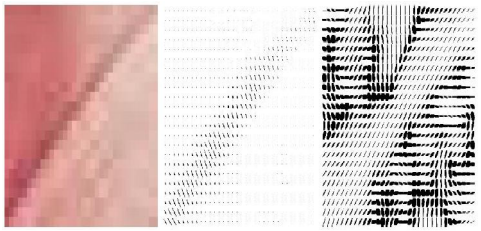

Figure 1: Sample Result of the Edge based Segmentation

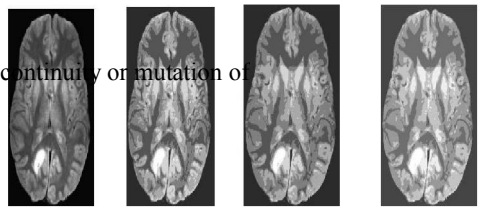

Figure 2: The Multiple M-L Model Base Segmentation

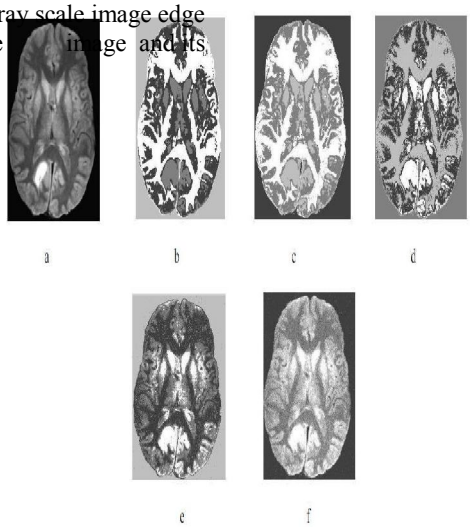

Figure 3: The Experimental Set One

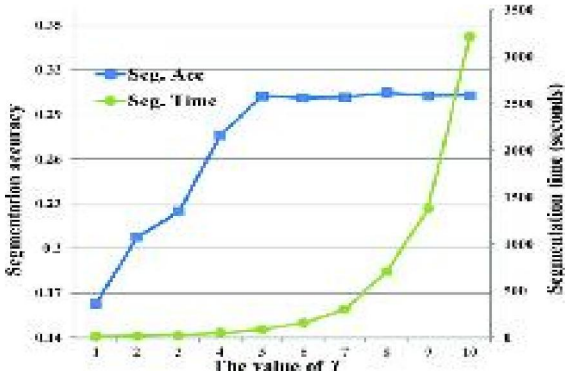

Figure5. The Numerical Simulation srt One

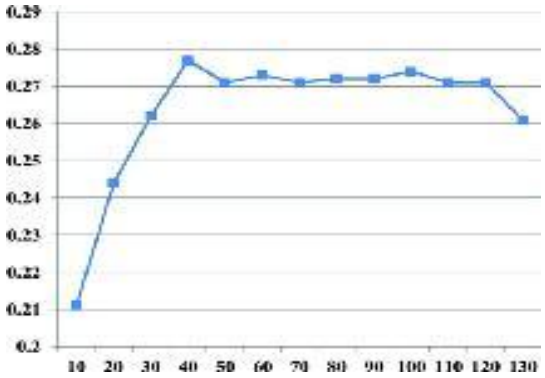

Figure 6: The Numerical Simulation srt Two

V. CONCLUSION AND SUMMARY

In this paper, the M-L model is proposed for medical image segmentation. Fuzzy the choice, the parameters of the fuzzy clustering is how to choose parameters in fuzzy clustering, choose different parameter may not only result in different optimal partitioning clustering segmentation is one of the good methods of segmentation of MR images. It is very suitable for processing things inherent uncertainty, and is not sensitive to noise, its use of the multivalued logic to describe complex system, can more accurately for image segmentation and it converts the binary logic of mathematics into continuous valued logic
and make it more close to people's way of thinking. However, in practice, fuzzy clustering technology still exist some problems to be further research. These problems embodied in feature space, but also great influence on the clustering speed, they are from different aspects affecting the speed and accuracy of clustering. Curved surface fitting method the basic idea is the image gray level as high, with surface to fitting a small window of image data.
As a result of the fitting surface is to meet a rational surface smoothness. Thus it can be make more smoothing of image noise. In the future, we will conduct more it related research to optimize the current methodology.

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