Research on Medical Image Segmentation Based on Fuzzy Clustering Algorithm

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Abstract

Objectives: The aim of the study is to apply the fuzzy clustering algorithm to medical image segmentation technology and analyze the application effect of the algorithm. **Methods:** In this study, the application of bacterial fuzzy clustering algorithm and bacterial foraging optimization algorithm in tooth image segmentation is analyzed. Among them, bacteria fuzzy clustering algorithm is a research group, whereas bacteria foraging optimization algorithm is a conventional group. Relevant researchers need to compare the separation index, partition coefficient, and partition index of the two algorithms. **Results:** Compared with the conventional group, the separation index and the partition coefficient of the experimental group were relatively high, and the two groups in the separation index and partition coefficients have a statistically significant difference ($P < 0.05$); compared with the experimental group, the index value was higher in the conventional group, and there was significant difference between the two groups in the zoning index ($P < 0.05$). **Conclusions:** Compared with the traditional bacterial optimization algorithm, the application of the bacterial fuzzy clustering algorithm in tooth image segmentation is more remarkable.

Keywords: Algorithm, bacterial foraging, fuzzy clustering, traditional bacterial

Introduction

The rapid development of information technology and the continuous improvement of computer application have promoted the rapid development of medical imaging instruments, such as line and digital gastrointestinal. It can realize the digitization of the human body from macro- to microstructure.[1] Further accurate simulation and three-dimensional reconstruction of human organs can effectively help doctors to carry out computer-aided diagnosis and formulate plans for internal and surgical operations. To improve the accuracy of disease diagnosis, the corresponding tissues or organs were dynamically simulated, and the structures and processes of the lesions were separated.[2] The key problem of using a medical image to simulate organ or lesion tissue is to segment medical image correctly and quickly. The pioneers of visual human studies have pointed out that the study of digital people has three challenging problems, namely segmentation, division, and red vision for many years. Many scholars and researchers have done a lot of research works on medical image segmentation and have made a lot of achievements. One after another, a new image segmentation method based on image segmentation is proposed. A method for image segmentation based on geodesic distance (based on mean shift), a method for image segmentation based on graph theory, a method for image segmentation based on mean shift, and a method for image segmentation based on graph theory. The image segmentation method based on random walking; the image segmentation method based on outburst region detection; the image segmentation method based on information theory; the image segmentation method based on the horizontal set; and the second class image segmentation method based on the level set.[3] However, most of the above

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methods aimed at the natural image segmentation, but the medical image is very simple because of the gray value. When the above algorithm is used to segment the medical image, the segmentation effect is not very good. There is still a long way to go for medical image segmentation to be correct, and how to improve the accuracy and speed of medical image segmentation is still a recognized bottleneck.

Overview

In this article, the medical image segmentation technology is studied based on the fuzzy clustering algorithm. The fuzzy clustering algorithm is a typical clustering algorithm in the field of machine learning and pattern recognition, the most typical of which is the fuzzy mean algorithm. The algorithm was first proposed and then extended. As the fuzzy algorithm can effectively deal with the partial volume effect phenomenon in medical images, the algorithm has become a hot research topic in the field of medical image segmentation in the past 10 years. In essence, image segmentation based on the algorithm is based on minimizing the weighted distance function between pixels and clustering centers to segment medical images. Different from the traditional mean algorithm, the fuzzy mean value method allows pixels to belong to different organs or tissues at the same time, that is to say, continuous logic is used to replace the traditional binary logic. This process can obtain more information from a given medical image, thus more in line with human thinking. However, the algorithm does not consider the neighborhood information of pixels in the objective function, which makes the algorithm more sensitive to the noise in the medical image. Therefore, the efficiency of the algorithm is low, which cannot meet the real-time requirements of medical image segmentation.

Methods

The process of image segmentation is also a process of clustering pixels in the image. It can be seen from the clustering process of the graph that the algorithm is used to cluster the pixels, and it is also the process of the change of the clustering center from the initial value to the final value. If the value of the clustering center is close to the final value of the clustering center at initialization time, the number of iterations of the algorithm can be reduced to a certain extent, and the efficiency of the algorithm can be improved. Based on this consideration, we propose two strategies to initialize clustering centers.[4] The first is to use the peaks detected in the histogram directly as the initialized cluster centers. The second one is to calculate the corresponding interval on the basis of obtaining the peak value and initialize the corresponding cluster center with the interval information.[5] To obtain the peak value from the histogram, this chapter takes the peak detection based on the idea of obtaining the corresponding number of peaks from the histogram of a given image. When the detection peak is initialized to the cluster center, although the efficiency of the algorithm has a certain increase, it does not achieve the desired efficiency. The efficiency of the operation is even a little lower for the image. The reason why the algorithm is inefficient can be found that the clustering center in the clustering algorithm is not the actual pixel but the base of the clustering algorithm.[6] The final clustering center in peak detection is the real gray value in the image. Therefore, using the detected peak as the initialization cluster center, it cannot improve the efficiency of the algorithm to a great extent. Based on this phenomenon, this chapter initializes the cluster center by the detected peak step to make it possible. It is possible to approach the final clustering center [Figure 1].

The reason for the low efficiency of the algorithm is analyzed from the point of view of clustering center calculation. In this part, it is considered that the efficiency of the algorithm is relatively low because the algorithm needs to involve all pixels in the given medical image when calculating the clustering center, which is obviously inconsistent with the characteristics of the medical image. An improved algorithm, that is, an improved algorithm based on the hierarchical technology, is proposed, which can effectively improve the segmentation efficiency of the algorithm. The core of the algorithm is to assume that the center of a cluster is determined by the pixels in the cluster rather than all pixels in the image. The key point of the algorithm is how to divide the given medical image into different tissues or organs. In this article, the peak detection technique is used to divide the given image into different tissues or organs. In this way, only the pixels in the tissue or organ are involved in the calculation of the center of the cluster, which can effectively reduce the computation amount and improve the efficiency of the algorithm. The way to improve the efficiency of the algorithm by initializing the clustering center is discussed, and the improved algorithm based on the histogram is explored effectively [Figure 2].

Results

The improved algorithm proposed in this article is not only superior to his algorithm in detail processing but also superior to other algorithms in overall segmentation effect. In detail, the segmentation results of the algorithm designed

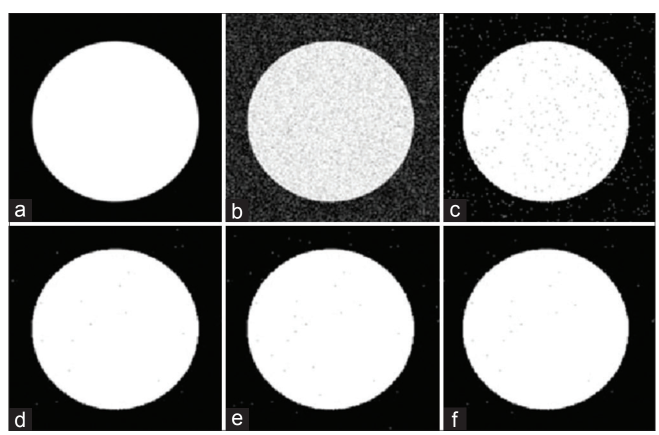

Figure 1: Medical images processed by IFCM algorithm. (a) Input image (Dataset ID 1), (b) Adaptive thresholding, (c) Maximum entropy thresholding, (d) Local statistics thresholding, (e) Region growing, (f) Edge detection (Canny)

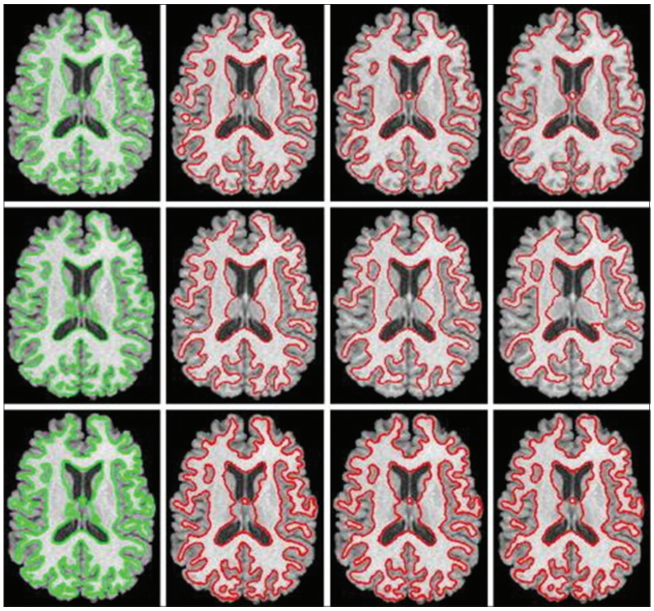

Figure 2: Medical images processed by IFCM algorithm

in this part are obviously less than those of other related algorithms, and the main components of the image can also be segmented in the whole segmentation. For example, in the segmentation of images, the algorithm designed in this article can separate the main components of thoracic cavity by adopting the initialization of clustering center, but the algorithm cannot meet this requirement. From the results of image and image segmentation, we can see that the algorithm and algorithm are better than the algorithm in dealing with details and boundaries; the main reason is that the algorithm only uses the statistical information of the image. In addition to the statistical information of the image, the algorithm also effectively uses the interval obtained on the histogram to guide the segmentation process of the image, thus effectively improving the segmentation results of the algorithm. The partition coefficient of the algorithm is optimal, the algorithm proposed in this part takes the second place, and the algorithm is the worst. This implies that in the algorithm clustering proposed in this part, the pixels are closer to the clustering center, which is the same as the original intention of the original algorithm; from the comparison, the algorithm and the algorithm proposed in this part are better, the algorithm is the second, and the algorithm is the worst; in the comparison of the error rate of image reconstruction, the algorithm and the algorithm proposed in this part are superior to the algorithm and algorithm [Table 1].

Conclusions

In this article, we first propose an acceleration strategy based on cluster center initialization. Based on the peak detection technique, the typical peak value on the vertical image is obtained as the initial cluster center to reduce the transition process from the initial value to the final value thus improving the efficiency of the algorithm. Considering that the clustering center of the algorithm is not the real gray value in the image, this article makes further calculation on the basis of the detected peak value and uses the calculated gray value as the initial clustering center. The efficiency of the algorithm can be improved to a certain extent. At the same time, an improved algorithm based on hierarchical technology is proposed to limit the computation of clustering centers to the corresponding tissues or organs, which can effectively reduce the number of pixels needed in computing clustering centers. Using the segmentation interval and the statistical information of the image to segment the image, the running efficiency of the algorithm can be further improved, and the segmentation effect of the algorithm can be guaranteed at the same time. The experimental results show that the algorithm can be segmented in less than seconds to meet the real-time requirements of medical image processing.

Table 1: Comparison of medical image algorithms

Methods	FCM	SFCM
KFC	426	679
IFCM	388	704
ECM	382	703

FCM: Fuzzy C-Means, SFCM: Spatial Fuzzy C-Means, KFC: Kernel-based Fuzzy Clustering, IFCM: Intuitionistic Fuzzy C-Means, ECM: Enhanced Compression Model

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Conflicts of interest

There are no conflicts of interest.

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