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Research on image segmentation based on clustering algorithm

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Abstract: Firstly, the gray mean values of the local area inside and outside the evolution curve are calculated, and the gray heterogeneity of the image can be captured by using the gray mean values of the local area. Secondly, in order to prevent the active contour model based on local information from falling into local optimum during the curve evolution process, the gray mean inside and outside the curve is used to construct the global energy term to drive the evolution curve to the target edge. Finally, the weight coefficient is constructed by the ratio of gray level of local region and global region, and the relationship between local energy term and global energy term is adjusted adaptively, so that the model adaptively adjusts the curve evolution with the change of image gray level. Experiments on natural images and brain tumor images show that, compared with traditional and some new active contour models; the proposed hybrid active contour image segmentation model has higher segmentation accuracy and is not sensitive to the initial contour.

Key words: Image segmentation; Active contour model; Intensity in homogeneity image

1. Introduction

The purpose of image segmentation is to divide the image into different sub-regions with unique characteristics according to the characteristics of the image, such as gradient information, texture information, color information, and so on, and extract perceptual regions from the process.Image segmentation is one of the basic tasks of computer vision, the quality of image segmentation results will have a direct impact on the subsequent image processing. Image segmentation is the basis of target detection, recognition and behavior analysis, which is widely used in various fields. In the medical field, the use of image segmentation technology can be convenient and accurate extraction of tissue lesions, which is helpful for doctors' diagnosis and treatment plan design. In the field of intelligent transportation, the number, location, license plate number and other information of vehicles can be obtained through image segmentation, which helps to improve the efficiency of traffic police in guiding traffic and dealing with traffic accidents. In addition, image segmentation also plays an active role in agriculture, remote sensing image processing and other fields, among which animal image segmentation is the basis of animal behavior analysis, population density research, and plays an important role in animal protection and environmental protection.

2. Hybrid active contour image segmentation model

In natural scenes, affected by illumination and other factors, the collected images usually have complex features, among which uneven gray distribution is one of the most common features, and also one of the important factors affecting image segmentation. However, the CV model uses the global information of the image to construct the energy function. When the gray scale of the image is unevenly distributed, the difference between the fitting value of the model and the real gray value of the image will be large, resulting in poor segmentation effect. Therefore, CV model can not effectively segment images with uneven gray distribution. In order to segment images with uneven gray scale, Li et al. proposed a Local Binary Fitting (LBF) model based on

Local energy, in which Gaussian kernel function was used to extract Local information of the image and calculate the gray mean of the Local area, making the Fitting value of the model more approximate to the real gray scale value of the image. Gaussian kernel function and gray mean are used to construct a new energy function, and the segmentation results of synthetic images and medical images show that the model has a good segmentation effect on images with uneven gray distribution. However, the model is sensitive to initial contour position due to the use of local gray information, and the evolution curve is easy to fall into local optimal. Pang et al. used the mean and variance of pixels in local regions to construct an energy function, and introduced the energy function into the level set function. The segmentation experiment of synthetic images and natural images showed that this method had a good segmentation effect on gray uneven images, but this method required the same mean value of the target and background. Shan et al. introduced the difference between the local gray mean value and the real image into the sigmoid function to construct two adjustment functions, and introduced the two adjustment functions into the level set function to construct a new energy function. The segmentation experiment of natural images and synthetic images shows that the model has a good segmentation effect on gray uneven images. However, this model can only process images with large contrast, and has poor segmentation performance for images with low contrast. Although the hybrid active contour model based on local region can effectively segment images with uneven gray distribution, the evolution curves are prone to fall into local optimal. In order to avoid the evolution curve falling into local optimum, Yang et al. combined global and local information to construct a new active contour model, which constructed global Signed Pressure Force Function (SPF) through global gray mean and median. Local SPF is constructed by using local gray mean and local pixel number, and finally a new energy function is constructed by combining global and local SPF. The segmentation results of synthetic images and medical images show that this method has a good segmentation effect on images with uneven gray distribution, but this model is only verified in simple background images. Fang et al. obtained the local gray mean by introducing the local space constraint term into the LBF model, and introduced the local gray mean and global gray mean into the edge indicator function to construct a new edge indicator function. Finally, the edge indicator function was introduced into the fuzzy active contour model to construct a new energy function. The segmentation results of natural images and synthetic images show that the model can effectively solve the problem of uneven gray level of images, but the segmentation performance of the model for weak edge images is poor. Although the above method combining local and global information can avoid the evolution curve from falling into local optimum to a certain extent, it still cannot completely avoid the evolution curve from falling into local optimum.

The evaluation of image segmentation results is an indispensable means in image segmentation and an important criterion for evaluating model performance. When evaluating the performance of image segmentation model, the method of combining qualitative evaluation with quantitative evaluation is usually adopted. Qualitative evaluation is a qualitative analysis of the segmentation results of the model, which has the advantages of strong visualization and intuitive comparison of segmentation results. However, qualitative analysis is usually greatly affected by segmentation results. When the segmentation results of different models differ greatly, qualitative analysis can accurately determine which model has better segmentation performance. When the segmentation performance of different models is similar, qualitative analysis can not accurately determine which model has better performance.

3. Experimental results and analysis

In the MATLAB environment, the texture feature extraction algorithm and the use of clustering technology texture clustering.

Experimental requirements:

A) Extract texture feature vector for every pixel in the synthetic texture image (there are altogether 4 synthetic texture images)

B) Use clustering technology (k-means clustering) to cluster points in the feature vector space, and the number of categories can be determined according to the actual number of texture classes in the image. Finally, category labels are mapped into images for display (as shown below, where B, D, F and H are corresponding benchmark segmented images).

Experimental steps:

1) In MATLAB, M file is used to write the feature extraction function code, and texture features are extracted by using the method of each feature value of gray co-occurrence matrix (GLCM).

2) In MATLAB, using k-means clustering technology, using M file to write texture clustering function.

3) In MATLAB, write the main function, read the four images through the cycle, process the four images respectively and output the classification results shown as figure 1.

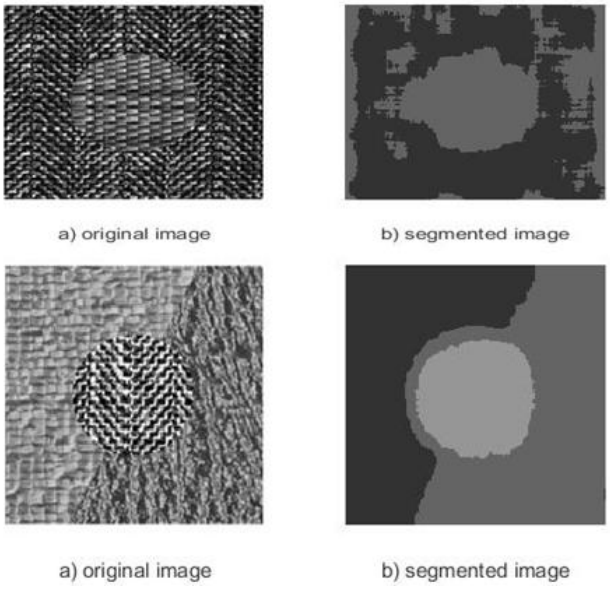

Figure1. Image segmentation experimental results

4. Concluding Remarks

In order to effectively segment images with uneven gray scale, blurred edge and low contrast, a hybrid active contour model combining local and global information is proposed in this paper. First using a rectangular window function to extract the curve evolution inside and outside the local area, to calculate the local grayscale average as model fitting values, can make the model fitting values better fitting real grey value of image, and by using the image grey value real structure and local energy, make model can better capture the image gray level irregularity; Secondly, the average value of the gray mean inside the evolution curve and the average value of the gray mean outside the evolution curve was used as the fitting value of the model, and the difference between the fitting value and the real gray value of the image was used to construct the global energy term, which drove the curve to the target edge evolution, so that the model could prevent the curve from falling into the local optimal in the evolution process.

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