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Image Segmentation Based On Variance Feature

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Abstract

Image segmentation ,Which performs the noise filtering and edge preserving smoothing processes synchronously, are developed in this paper .This process ,cleans the noise ,and in the same time ,does not blur the edges of the image. An ensemble of pixels, coupled in a local region ,is used for grouping purpose .This task is implemented via the introducing a set of neighborhood. Such task may generate groups associated with a specific pixel based on the similarity principle.

The task of this work presented in this paper applies on the syntactic, medical ,satellite images. The simulation results demonstrate the effectiveness of the developed algorithm.

الخلاصة

في هذا البحث تم تطوير طريقة لتجزئة الصورة تعمل على تنقية الضوضاء والمحافظة على تنعيم الحافة في نفس الوقت، تقوم هذه العلمية بإزالة الضوضاء بدون أية تشويش لحواف الصورة. تعتمد هذه الطريقة على تجميع بكسلات الصورة في منطقة محلية من خلال اعتماد مبدأ التجاور، وتنجز هذه المهمة من خلال توليد مجاميع مرتبطة مع بكسل خاصة على اساس مبدأ التشابه.

تم تطبيق هذا البحث على مجموعة من الصور التحليلية، الطبية، صور الاقمار الاصطناعية، نتائج المحاكاة وضحت مدى كفاءة هذه الخوارزمية المطورة.

I. Introduction

One of the fundamental tasks in computer vision is image segmentation. It is the process to partition an image into a number of coherent regions the pixels belonging to the same region should have similar properties in terms of intensity, color, and texture etc., while two adjacent regions should have dissimilar properties. Although humans perform the task without difficulty, image segmentation remains one of the most challenging problems in machine vision.

Image denoising and segmentation play an important role in image analysis and computer vision. Image denoising reduces the noise introduced by the image acquisition process, while image segmentation recovers the regions associated to the objects they represent in a given image. Image segmentation typically relies on semantically poor information, directly obtained from the image around a spatially restrained neighborhood and, for this reason, is broadly classified as a *low-level* treatment (Cocquerez and Philipp, 1995).

Image segmentation often requires pre- and post-processing steps, where user judgment is fundamental. Pre-processing is an essential step, in which specialized filters smooth the image, simplifying it for the subsequent segmentation step. This is outlined in some detail by (Mirmehdi and Petrou, 1998) Which they are not concerned with segmentation itself, but with the preprocessing smoothing stage of the image which is critical for a good segmentation. They utilize the ZW kernels within a multiscale segmentation framework for smoothing the image to a level where in the coarsest version the directly textured areas become patches of almost uniform color.

In order to achieve good segmentation performance, a smoothing technique is often employed for noise removal prior to the use of a segmentation method, which results in a two-stage segmentation approach. So due to severe noise appearing in images, the images must be filtered before reasonable segmentation can be done. This operation is called image-smoothing (Lu , 1992).

Interactive segmentation allows the user to intervene directly in the segmentation process thus contributing to its success. Additionally, post-processing may be required to complete the task, if the segmentation itself fails to produce the desired results.

In this research we denoise an image while image object is detected which leads to robust performance for image segmentation. For fast computation, we build on the work feature preserving smoothing algorithm (FPS) (Chenyz and Deliang ,2000). A salient feature of our algorithm is its robust performance in noisy image segmentation.

2. Principle of the Algorithm

By far the most smoothing filter used in smoothing is the Gaussian filter (Konzales and Woods, 1997) .Such a filter has very desirable properties, in particular this filter may alleviate edges in the image. More importantly, the image filtering technique should able to reduce the level of noise but not at the expense of feature preservation

So we utilize notations from (FPS) algorithm based on the robust statistics. Unlike the previous methods, we adopt a proposed measure to detect discontinuities in an image, (spatial variance is employed to form a measure for detecting contextual discontinuities that can be used for preservation and control of the smoothing speed

We get a non iterative feature preserving filtering with simplicity and efficiently implementation drive .At the begin we calculate the variance on the lateral neighborhood of pixel.

$$\sigma_{ij}^2(R)=\frac{\sum_{(m,n)\in N(i,j;R)\cup(i,j)\}} I_{mn}^2}{\left|N(i,j;R)\right|+1}-\left(\frac{\sum_{(m,n)\in N(i,j;R)\cup(i,j)\}} I_{mn}}{\left|N(i,j;R)\right|+1}\right)^2 \qquad (1)$$

$$N(i,j,R)=\left\{(k,l)\middle| i-R\le k\le i+R,\ j-R\le l\le j+R,(k,l)\ne(i,j)\right\}$$

Where R (R>=1) is a parameter that determines the size of the lateral neighborhood ,and I_{ij} I_{kl} are the intensities of center (I,j) and neighborhood (k,l) pixel respectively . The normalized variance $\sigma_{ij}^2(R)$ is calculated through multiply it by (norm) parameter . In fact $\sigma_{ij}^2(R)$ reflects the relative degree of the lateral discontinuities for pixel and a large value of $\sigma_{ij}^2(R)$ indicates that the pixel ‘s lateral discontinuities likely correspond to significant features and vice versa. This suggests that the local attributes of a pixel with a high lateral discontinuity should be preserved and those of a pixel with a low lateral discontinuity should be adapted toward homogeneity. Using $\sigma_{ij}^2(R)$ we present ***new I_{ij}*** as shown below

$$newI_{ij}=I_{ij}+\frac{\sum_{(k,l)\notin N(i,j,1)}\eta_{kl}(I_{kl}-I_{ij})}{\sum_{(k,l)\notin N(i,j,1)}\eta_{kl}} \qquad (2)$$

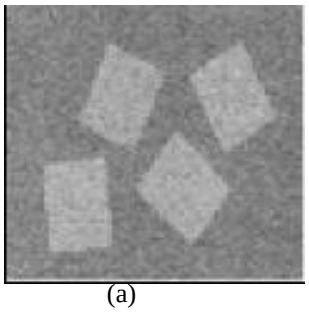
$$\eta_{ij}=\exp(-s\phi(\sigma_{ij}^2(R),\theta_\sigma))$$

(s>0) is used to determine to what extent feature should preserved in term of lateral discontinuities. the function ϕ is defined as $\phi(\sigma_{ij}^2(R),\theta_\sigma)=0$ if $\sigma_{ij}^2(R)<\theta_\sigma$ and $\phi(\sigma_{ij}^2(R),\theta_\sigma)=\sigma_{ij}^2(R)$ if $\sigma_{ij}^2(R)>\theta_\sigma$ $\theta_{\sigma(}(0\le\theta_\sigma\le 1)$ is a threshold used to alleviate the influence of the noise in the estimation of lateral discontinuities .

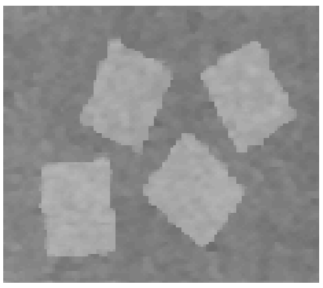
3. Experimental results

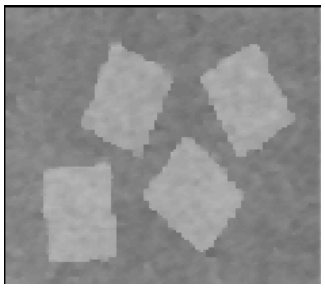
The algorithm described in the previous section was used to test, synthetic , sample of biomedical ,and satellite images.

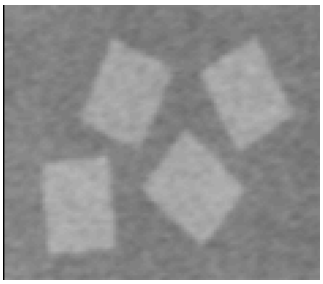
In the experiment (1), we apply our algorithm on a 120×120 pixel , 8 bits gray level synthetic image, best state we get when the value of the threshold (θ=0.05) , Our algorithm segments the image into four parallelograms and image background , (s=4, norm =0.01) in all states, and when the threshold value begin increased, we note that the results images are very smoothed and the operation like apply mean filter on the images .The reason is that the function $\phi(\sigma_{ij}^2(R),\theta_\sigma)$ return either zero or $\sigma_{ij}^2(R)$, and when the value of threshold θ is increased then the value of the function become zero, and this make the value of the $\eta_{ij} = \exp(-s\phi(\sigma_{ij}^2(R),\theta_\sigma))$ =1 which discard its effect on the image which make mean operation has been performed as shown in the Fig.1.



(a)



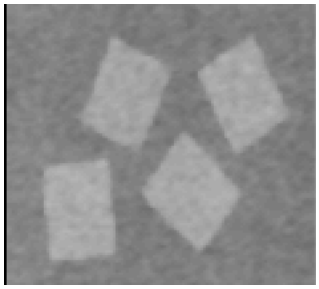


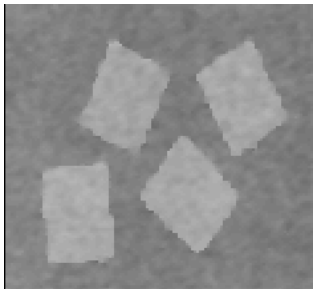


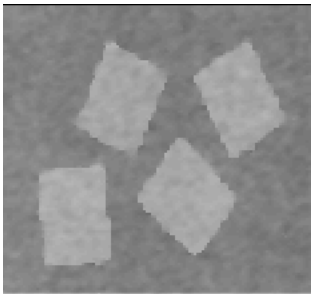
(b) (c) (d)

Fig(1) (b,c,d) are segmentation results on the synthetic image (a) when the values of threshold in the states (b,c,d) are (0.05,0.5,5) respectively .

Experiment (2). the images in the (Fig .2) appears to be high contrast as the value of the **s** is increased, (threshold=0.1,norm=0.001) in all states, since the value of the η_{ij} is decreased which lead to make some of consistency between the pixel and its neighbors **.**



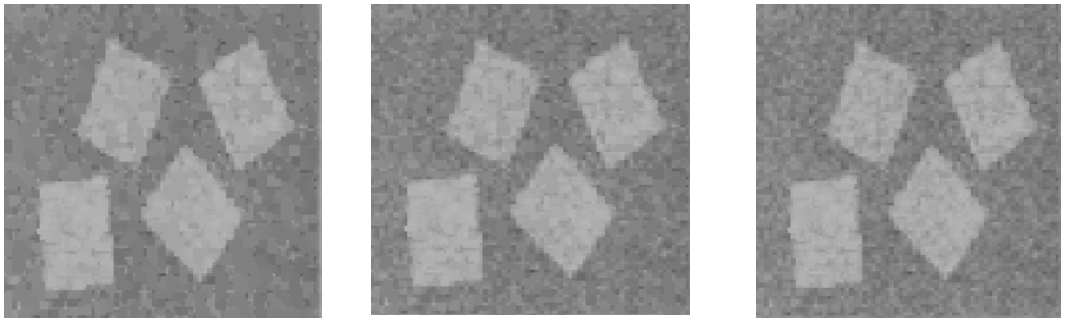




(a) (b) (c)

Fig(2) (a,b,c) are segmentation results when the values of the parameter s in the states (a,b,c) are (4,50,100) respectively .

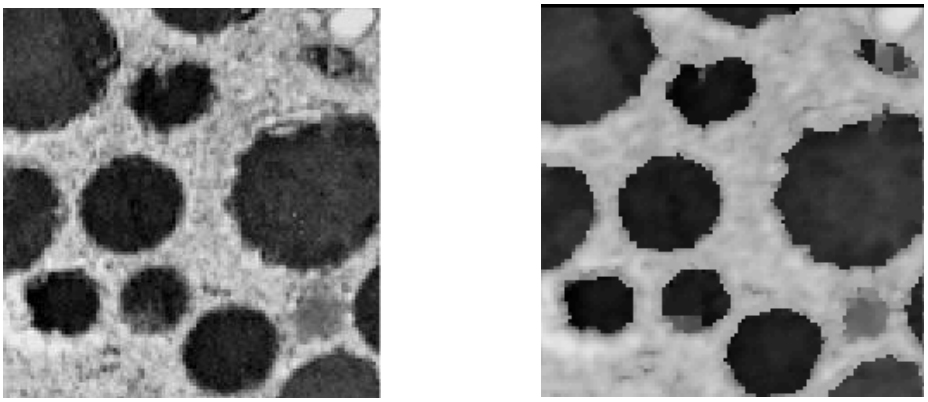
Fig (3) clarify the experiment (3).in this experiment we get noise images as the value of the **variance** is high with high values to the **s** parameter this make the value of the η_{ij} is become so low which add some noise on the results images (threshold=0.1,norm=1)



(a) (b) (c)

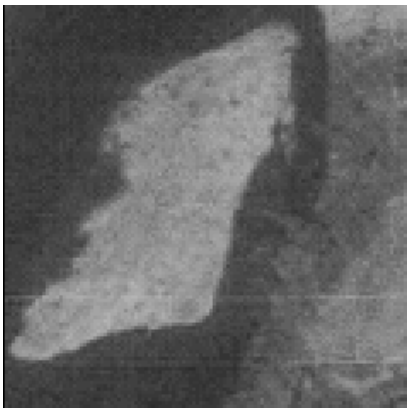
Fig(3) (b,c,d) are segmentation results when the values of the parameter s in the states (a,b,c) are (4,10,100) respectively .

Also in Fig.4b the algorithm yields more homogeneous regions and more precise boundaries between different regions on the 114*120, 256 cell sample of the skin image , Fig. 5a shows an aerial image severely corrupted by noise. Again, we apply our algorithm to display the segmentation results. As illustrated in Fig. 5b, we observe that leader pixels will spread its activity over the whole pixel group, which represent an image object.

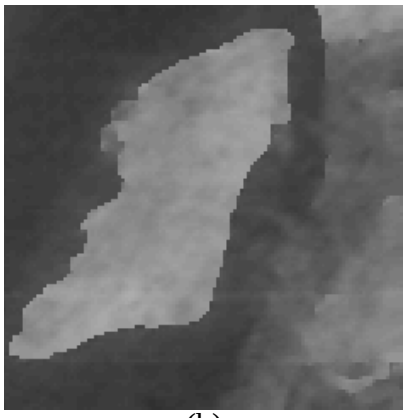


(a) **(b)**

Fig.4 Segmentation results for a skin cell image. (a) Skin cell image. (b) Segmentation result (s=4,norm=0.01,threshold=0.1)



(a)



(b)

Fig. 5 Segmentation results for satellite image. (a) Original image. (b) Segmentation result (s=4,norm=0.01,threshold=0.1)

5. Discussion

The user –defined homogeneity test is largely application dependent ,but the general idea is to look for feature that will be similar within an image and different from surrounding object ,simple feature is the gray level .here we used gray level variance as homogeneity measure when the gray level variance within a region must less than some threshold, where each sample (pixel) has an influence on all the other, but samples far a way from each other interact only very slightly.

Our method provides reliable segmentation results to synthetic, sample of biomedical images and satellite images ..

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