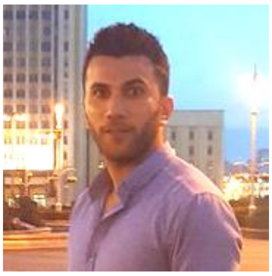
SELECTION TEXTURE REGIONS ON THE IMAGE BASED ON CLASSIFICATION ASSESSMENT DENSITY OF CONTOUR ELEMENTS

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Abstract. A method for texture images segmentation based on selection texture regions on the image based on classification assessment density of contour elements. The goal of the method find the contouring of the image, determining the position of contour elements in the image and classify it for different types(points, lines, and shapes) close the region which had same type of contour type into binary regions objects. The result will be representing in binary matrix.

Introduction. Texture segmentation and contour analysis provide an important information for machine vision tasks such as scene classification, surface orientation, and shape determination and so on. Contour analysis (e.g. edge detection) may be adequate for untextured images, but in a textured region it results in a meaningless tangled web of contours. For example, the detection of the edge will return to the region in the beans as shown in Fig. 1. The all old solutions problem in edge detection went to use a high threshold so as to minimize the number of edges which can found in the texture area. This is obviously a non-solution—such an approach means that low-contrast extended contours will be missed as well [4].

Fig. 1. Use Prewitt and Roberts filters for the image using different thresholds:
(a) low threshold level, (b) high threshold level.

In this paper; we proposed a method is to develop iterative algorithm selection texture regions on the image based on classification assessment density of contour elements [2, 3]. We are chosen texture images from Brodatz textures with different and the method texture image segmentation based on classification of contour elements and logical addition of classes [5] are used to classify the image to different types like (point, line, cell, spot) and find the central pixel for each class and use the proposed method to find the homogenous (texture) regions in the image as shown in Fig. 2.

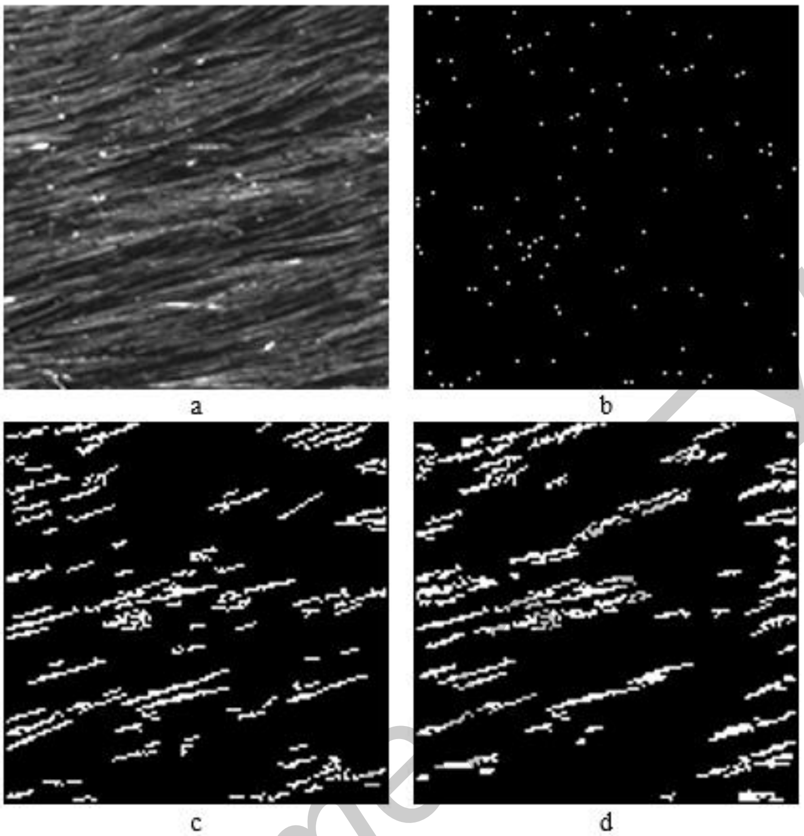

Fig. 2. (a) texture image, (b) point in image (a), (c) line in image (a), (d) spot in image (a)

The algorithm of selection texture regions on the image based on classification assessment density of contour elements. The algorithm selection texture regions on the image based on classification assessment density of contour elements the input image for the algorithm is a binary image

$$B = \left\| b(y,x) \right\|_{\left(y=\overline{0,Y-1},\, x=\overline{0,X-1}\right)} \tag{1}$$

of isolated homogeneous regions. The maximum allowable number of iterations $\hat{N}_C$ and the segment area $\hat{S}_S$, $\hat{N}_S$ the segments number where Y, X the size of the input image vertically and horizontally, $b(y,x)$ - A pixel of the input image, takes the value 1- for homogeneous segments and 0 - for the zone. The algorithm allows combining isolated regions in the larger region and then combines them until will be provided with the specified output conditions of the algorithm ($\hat{N}_C$ the maximum number of iterations, $\hat{S}_S$ segment area, $\hat{N}_S$ the number of segments).

The algorithm consists of the following steps:

1) Start the iteration

$n_C \leftarrow 0$

2) Start the iteration and combination of isolated homogeneous regions.

Segmentation of the homogeneous regions in the image. In this step the input image B is associated with a matrix

$$S_B = \left\| s_B(y,x) \right\|_{\left(y=\overline{0,Y-1},\, x=\overline{0,X-1}\right)} \tag{2}$$

the value of each element

$$s_B(y,x) \in [0, N_S] \tag{3}$$

which indicates for segment number, which it belongs, where N_S -The number of segments. Elements $s_B(y,x)=0$ they belong to the zone. For the image segmentation in this step are used the method of region growing [1].

3) Define the area for the segments. For all segmentsFormed by the pixels of the input image, the values which $b(y,x)=1$ segment $\mathrm{S}_S(n)$all pixels (the area) of the segments by using the equation

$$(b(y,x)=1) \Rightarrow (\mathrm{S}_S(s_B(y,x)) \leftarrow \mathrm{S}_S(n)+1) \tag{4}$$

when $x=\overline{0, X-1}$, $y=\overline{0,Y-1}$, where $n \in [1, N_S]$ – the number of the segment, when initialization $\mathrm{S}_S(n) \leftarrow 0$ when $n=\overline{1,N_S}$

4) Determine the maximum area of the segments by using the equation

$$(\mathrm{S}_S(n) > \mathrm{S}_{\max}) \Rightarrow (\mathrm{S}_{\max} \leftarrow \mathrm{S}_S(n)) \tag{5}$$

when $n=\overline{1,N_S}$ when initialization $\mathrm{S}_{\max} \leftarrow 0$

5) Define the size of the segments. For all segments formed by the pixels of the input image, the values which $b(y,x)=1$. Calculate the coordinates of the left $x_L(n)$, right $x_R(n)$, upper $y_H(n)$, lower $y_N(n)$ pixels by using the equation

$$\begin{aligned}(b(y,x)=1) \Rightarrow {} & ((x < x_L(s_B(y,x))) \Rightarrow (x_L(s_B(y,x)) \leftarrow x)) \\ & ((x > x_R(s_B(y,x))) \Rightarrow (x_R(s_B(y,x)) \leftarrow x)) \\ & ((y < y_H(s_B(y,x))) \Rightarrow (y_H(s_B(y,x)) \leftarrow y)) \\ & ((y > y_N(s_B(y,x))) \Rightarrow (y_N(s_B(y,x)) \leftarrow y))\end{aligned} \tag{6}$$

when $x=\overline{0,X-1}$, $y=\overline{0,Y-1}$when initialization $x_L(n) \leftarrow X-1$, $x_R(n) \leftarrow 0$, $y_H(n) \leftarrow 0$ when $n=\overline{1,N_S}$

6) Calculate the coordinates for the centers for each segment. For all segments calculate the coordinates of their centers by using the equation

$$\begin{aligned} x_C(n) &= (x_L(n)+x_R(n))/2 \\ y_C(n) &= (y_L(n)+y_R(n))/2 \end{aligned} \tag{7}$$

when $n=\overline{1,N_S}$

7) Find the overlap between the segments. For each iteration great new matrix $dnc(y,x)$ Put overlapping segments in new matrix

$$\left(d_{nc}(y,x) \leftarrow b(y,x)\right) \tag{8}$$

And delete overlapping segments from $b(y,x)$ in the case of increasing the size of images can lead to a substantial increasing in the running time of this step and in the result is a Low speed algorithm as a whole.

8) Increase the counter for the loop by using the equation $n_C \leftarrow n_C + 1$

9) Check the conditions for the end of the loop. Exit from loop by doing any of the following conditions:

$$n_C = \hat{N}_C \tag{9}$$

$$N_S < \hat{N}_S$$

10) Combine the matrixes

$$\left(d_f(y,x) \leftarrow d_{nc}(y,x)\right) \tag{10}$$

according to this condition ($N_S > 6$) where $\hat{N}_S$ number of segments as explained above.

An example of the algorithm of selection texture regions on the image based on classification assessment density of contour elements. Fig. 3 shows the some of test of texture images and Contour filtering. images, distributed by several binary images; each one contains a homogeneous area points, lines, spots. For texture segmentation are used the method based on the selection texture regions on the image based on classification assessment density of contour elements. The goal of this method find a contour pixels of the input image, search the position of the contour elements and classify it's for different types (points, lines, and shapes) convert each region which had same contour to one segment, binary coding and mutual arrangement obtained polygon objects in the boundaries of the input image, segmentation resulting is formed as a code in the matrix.

As shown in Fig. 4, the result of tests image in Fig. 3(a, c), of The algorithm selection texture regions on the image based on classification assessment density of contour elements and the result of the method based on energy map.

In the table 1.The error of texture segmentation for each test image. The proposed method can reduce the average segmentation error to 14 times in comparison with the methods based on energy map.

Table 1. The values of errors in the texture segmentation of test images

Imge	Method	
	Proposed method	Method based on energy map
	An error in the texture segmentation for test images	
Cell; long line	0,0814	0
long line; spot	0,0501	0,0104
Cell ; point	0,0108	0
Point; short line	0,0344	0,0050

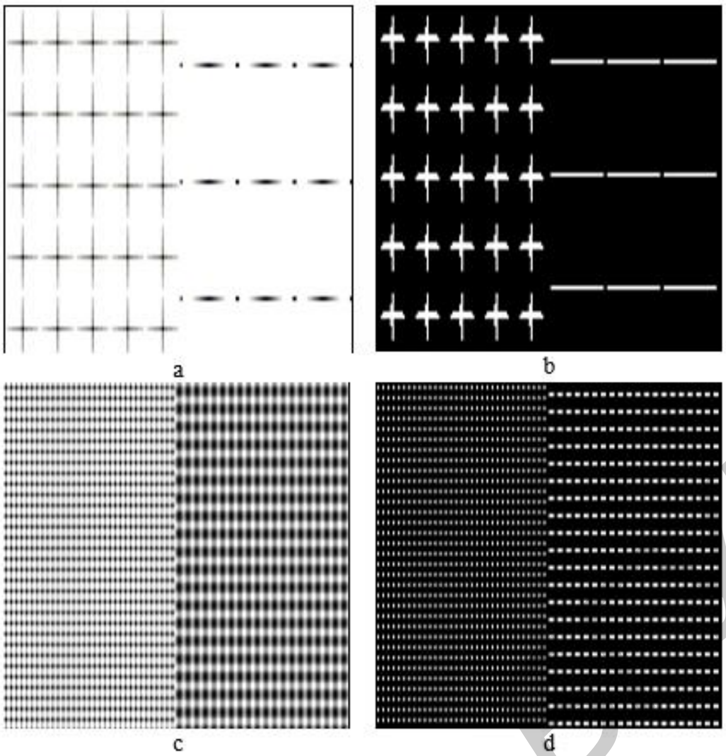

Fig. 3. Some tests images : a) cell, long line image ; b) contour for image (a);
c) point, short line image; d) contour for image (c)

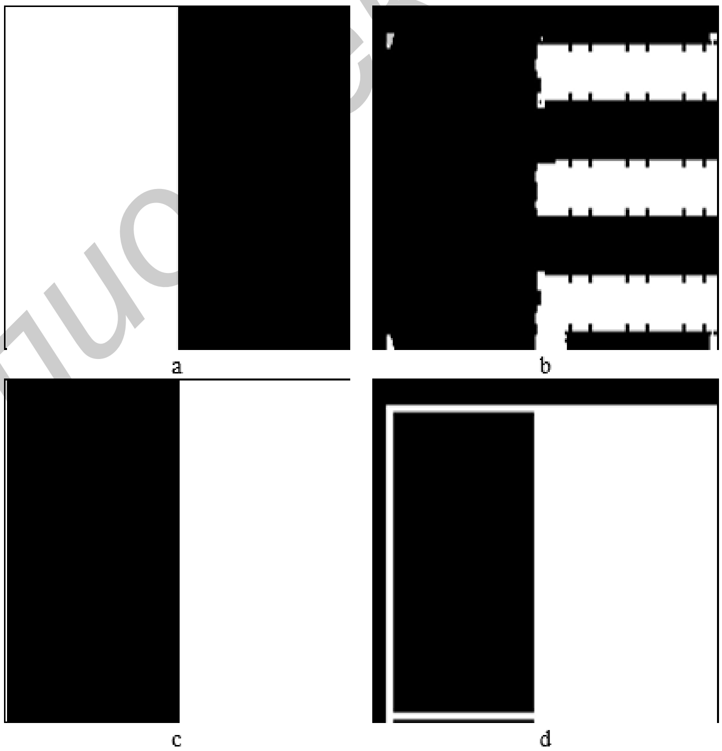

Fig. 4. a) segmentation result for image in Fig. 3(a) based on proposed method ; b) segmentation result for image in Fig. 3(a) based on energy map; c) segmentation result for image in Fig. 3(c) based on proposed method; d) segmentation result for image in Fig. 3(c) based on energy map;

In the table 1.The time of texture segmentation for each test image. The proposed method increase the time for segmentation to 18 times in comparison with the methods based on energy map.

Table 2. The values of errors in the texture segmentation of test images

Imge	Method	
	Proposed method	Method based on energy map
	Time of texture segmentation for test images	
Cell; long line	4,7793	1,7508
long line; zone	12,8403	1,7606
Cell ; point	15,1225	1,7458
Point; short line	129,473	1,7128

Summary. The algorithm selection texture regions on the image based on classification assessment density of contour elements, based on a search of the position of the contour pixel in the image and classify it's to different types. The advantages of propose method is:

4 Texture analysis or texture classification: define the contour element in the image and locate its as binary boundaries, classify theses contour elements for different type (point, line, cell, shape).

5 Texture segmentation: define the homogeneous regions, it helps to search different size of homogeneous regions and segment it as shown in the experimental above. The algorithm selection texture regions on the image based on classification assessment density of contour elements can reduce the average segmentation error to 14 times in comparison with the methods based on energy map and increase the increase the time for segmentation to 18 times in comparison with the methods based on energy map.

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