Texture Decomposition Using Morphology Image Processing

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Abstract **-** This paper explores multiple structure elements technique and used for image decomposition. The morphological operations are extended to a more general method that uses the multiple structuring elements combined with other operations, such as logical operations. Two procedures based on the multiple structuring elements morphological processing method have been developed, and these two procedures are implemented to extract the fibers with specific thickness from the fibrous non woven material images. The combinations of morphological operations with other set operations and the utilization of multiple structuring elements enhances the performance of morphological-based filters.

Keywords **-** *Morphology, Texture, structuring elements, histogram, threshold*

I. INTRODUCTION

Mathematical morphology, also called morphological filtering, provides an effective tool for image processing and computer vision. Many tasks in image processing and image analysis can be approached or solved through the means of mathematical morphology. This methodology is widely used to decompose images, to detect edges, and to suppress noise. Mathematical morphology is also used in shape representation.

The basic morphological operations are defined between two sets, *A* and *B*, where *A* is the set representing an image we want to process and *B* is called the structuring element. Morphological filters are thus designed by using the shapes of the objects in an image and the goal of the task. This concept of mathematical morphology offers great flexibility to design the structuring elements with different shapes and sizes according to the specific task. The basic morphological operations with binary and gray-scale image are erosion, dilation, opening and closing. Morphological image processing is nonlinear transformation that locally modifies the geometric features of images such as their peaks and valleys. Morphological image processing involves the interaction of the shapes of the objects in an image and compact sets of chosen shape and size, called the structuring elements. The interaction process is done through set operations.

II. MULTIPLE STRUCTURING ELEMENTS

In order to use morphological operators ore effectively, combinations of morphological operators with other operations and the use of multiple structuring elements have been introduced a morphological approach is used to extract objects of specific shape from synthetic images and subsequently in a texture image. A synthetic image containing line segments is created to help analysis the texture decomposition by using the morphological opening operation.

III. DECOMPOSE TEXTURE IMAGE

A. Preprocessing histogram Equalization

In the web material image, there are many fibers of small diameters whose gray-scale intensities are close to the background, thus the morphological operators will .fail to distinguish those fine fibers from the background. In order to enhance the details in the web material image to help morphological operations achieve better result, the histogram equalization is utilized as the preprocessing technique.

If the image histogram is considered as a probability distribution, from an information theoretic stand-point, the distribution which conveys the most information is a uniform distribution Therefore, if the gray levels are redistributed to obtain as a uniform histogram as possible, the image information is maximized, thus the details in the image are enhanced. It has been shown that histogram equalization can be obtained by replacing each normalized gray level with the cumulative distribution from the minimum gray level up to that gray level. For an image with gray scale varying in [0, *L]*, where *L* is the number of gray levels, the histogram equalization for this image is given by the relation

$$S_K = T(r_k) = \sum n_j / n \qquad 0 \quad S_K \le 1,\ 0 \le r_k \le 1$$

$$\text{and} \qquad k = 0,1 \ldots\ldots L-1$$

where ***nj*** is the number of times of the ***jth*** gray-scale intensity appears in the image and *n* is the total number of pixels in the image, and *T(r)* is the transformation function which maps the original gray level to the gray level in the resulting image.

B. Applying the Morphological Technique to Decomposing Texture Image

Two procedures are developed to enhance the web material image. The two procedures are established on the multiple structuring elements concept combined with logical operation. They are as following.

First procedure:

1. Input image G (i, j).
2. Apply the histogram equalization to the G (i, *j),* the resulting image is denoted as *GT(i,j).*
3. Apply the opening operation to *GT (i,j)* by using eleven structuring elements, creating the output images *GTO(k)(i, j),* where *k* = 1,….,11.

4. Produce the image *GM (i,j)* by taking the maximum of the images *GTO(k)(i,j)* at each location (i, *j*). ,

5. Compare the image *GM (* i, j) to the *GT (* i, j) at the location (i, *j*), if $|GM(i,j) - GT(i,j)| < t$, where t is a threshold, in this work $t = 20$, then the output image $Go(i,j) = GT(i,j)$, otherwise $Go(i,j) = 0$.

The structuring elements which were used in Step 3 in the above procedure for enhancing the web material image are the line segments in eleven directions: 0, 15,27, 45, 63, 75, 90, 117, 125, 135, 153 (degrees).

Second procedure:

1. Input image *G (i,j).*

2. Apply the histogram equalization to the G *(*i, *j),* the resulting image is denoted as *GT (i,j).*

3. Apply the opening operation to *GT (*i, j) by using eleven structuring elements, creating the output images *GTO (k)(i,j),* where $k = 1, \ldots, 11$.

4. Produce the image *GM (* i, j) by taking the maximum of the images *GTO(k)(*i, j) at each location (i, *j).*

5. Compare the image *GM (* i, j) to the *GT(*i, j) at the location (i, *j),* if $|IGM(i,j) - GT(i,j)| < t$, where t is a threshold, in this work $t = 20$, then the output image $G'(i,j) = G(i,j)$, otherwise $G'(i,j) = 0$.

The only difference in the second procedure from the first one is that the candidate pixel for output image G' is taken from the original input image *G* instead of the histogram equalized version *GT.*

IV. CONCLUSION

A multiple structure elements technique is introduced and used for image decomposition. We have further developed two procedures to decompose a texture image based on the multiple morphological processing technique. Those two procedures have been used to extract objects of different sizes from the synthetic images. In order to extract the fine details whose gray scale intensities are close to the background in the image, the histogram equalization is employed as a preprocessing technique. Comparison of the results with histogram equalization and without it shows that much better result is produced if the preprocessing technique is used before the morphological operations are applied. Finally, two procedures are applied to decompose the web material images.

V. REFERENCES

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