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TEM Color Image Segmentation using Hill Climbing Algorithm

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Abstract-TEM image is rapidly gaining prominence in various fields. Since high resolution TEM image captures huge amount of information, it is important to understand image segmentation techniques on it. The goal of image segmentation is to cluster pixels into salient image regions, i.e., regions corresponding to individual surfaces, objects, or natural parts of objects. To have region based image retrieval features can be mapped to various feature spaces on the basis of grouping algorithms. Using low level features of luminance and color, some salient features can be determined. This paper makes use of Hill Climbing algorithm on nanoscopic TEM image to obtain some low level features. With the same size and resolution of input image, it gives high quality saliency maps.

Index Terms: TEM Image, Hill Climbing Algorithm, luminance and color, Feature extraction

I INTRODUCTION

Detection of salient image regions of TEM image is useful for applications like image segmentation, adaptive compression, and region-based image retrieval. The goal of image segmentation is to cluster pixels into salient image regions, i.e., regions corresponding to individual surfaces, objects, or natural parts of objects. With respect to surrounding, salient features are identified [1].The paper intends to find high quality saliency maps of the same size and resolution as the input image and their use in segmenting whole objects. The method is effective on a wide range of images including those of paintings, video frames, and images containing noise. All methods use some means of determining local contrast of image regions with their surroundings using one or more of the features of color, intensity, and orientation [2].

II THEORY

Our method for finding salient regions uses a contrast determination filter that operates at various scales to generate saliency maps containing saliency values" per pixel [3]. Saliency maps are created at different scales use saliency calculation method described below. Thereafter all these maps are added pixelwise to get the final saliency maps. The input image is then over-segmented and the segments whose average saliency exceeds the threshold value are selected [2].

Let $C_{i,j}$ be the contrast based saliency value for any pixel whose position is (i,j) with inner region as I_1 and outer region as O_1. It is calculated as

$$Ci,j = D\left[\left(\frac{1}{N1}\sum_{p=1}^{N1} vp\right)\left(\frac{1}{N2}\sum_{q=1}^{N2} vq\right)\right]$$

Here, D is Euclidian distance or Mahalanobis distance depending upon whether vectors elements are uncorrelated or correlated.N1 and N2 are the number of pixels in the inner region I_1 and outer region O_1 respectively.

Inner region I_1 is taken as one pixel but if it it is noisy it can be a small region N*N

Let the width of an image be w and height of the image be h. Width of second i.e. outer region w_{o1} can be varied as

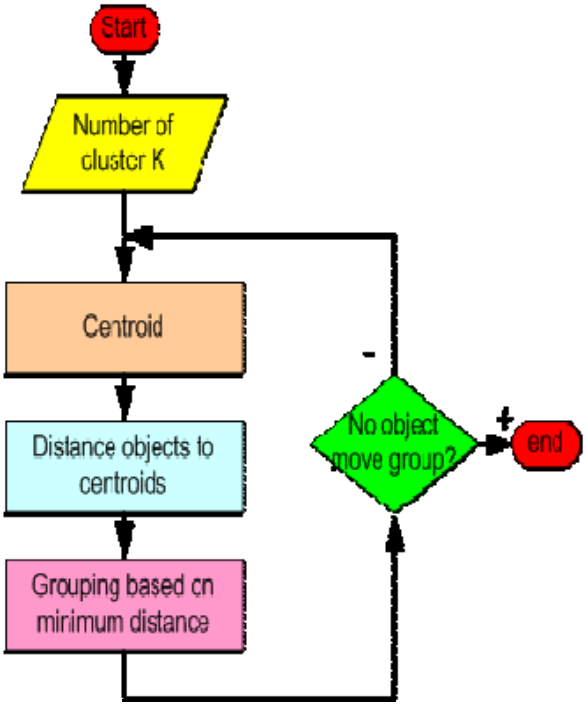
$$\frac{w}{2} \leq (w_{O1}) \geq \frac{w}{8}$$

Final saliency map is determined as a sum of saliency values over the scales.

$$m_{i,j} = \sum C_{i,j}$$

For all values of i in [1,w] and j in [1,h]

Now, to find the over-segmented image, K-means algorithm is used.



K Means Algorithm

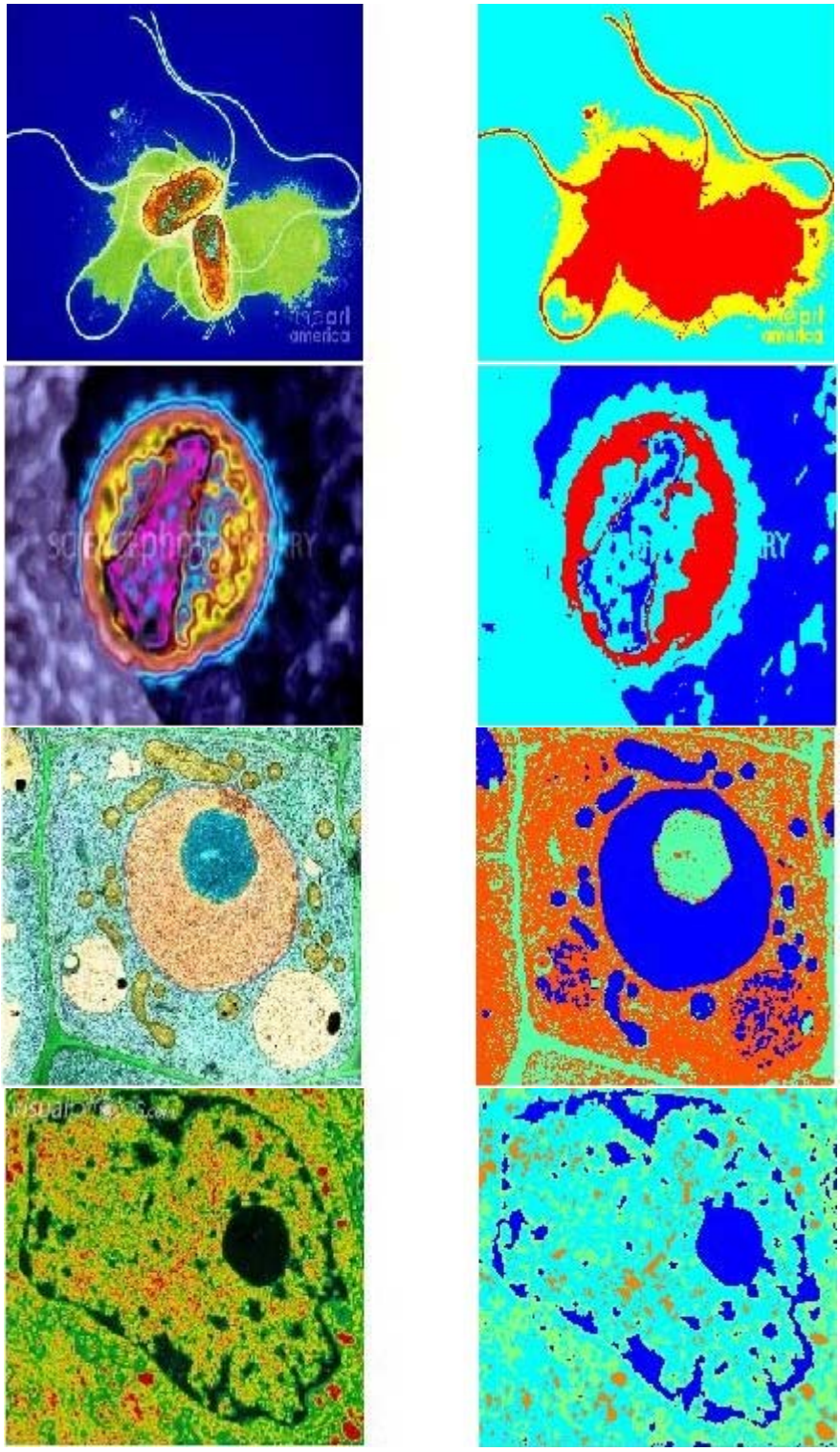
To find k seeds of this algorithm Hill Climbing Algorithm is used. The values of peaks forms the initial seed values and the number of peaks is K. For each segmented region the saliency values obtained are averaged. Thereafter, if it is less than the threshold then is discarded.

III HILL CLIMBING ALGORITHM

Hill Climbing algorithm detects the peaks globally in three dimensional color histogram. Basic outlines of the hill climbing algorithm is as follows.

1. Find the color histogram of image.
2. Starting with non zero bin , the uphill move is made if the number of pixels in the current bin is different from other bins towards the bin with greater number of pixels and we continue it till we find no neighbouring bin with larger number of pixels.
3. These initial peaks are the number of clusters.
4. Neighbouring pixels that lead to the same peaks are grouped together

IV SIMULATION RESULTS



Orginal Image **Segmented Image**

V CONCLUSION

This method of saliency features extraction using low level features of luminance and color using hill climbing algorithm is very fast and very effective.

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