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Synthetic Fiber Image Segmentation using a Cooperative System of Local Hill Climbing Optimization and K-Means Clustering

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Abstract*: *The proposed method explains the segmentation of synthetic fiber images based on the cooperative approach of local hill climbing and k means clustering. In this work, RGB image is transformed into CIELch space for the efficient extraction of the hidden treasure in the images. The combined approach of local optimization search technique, HC and KMC is applied for the segmentation of synthetic fiber images. This color histogram based technique works on the principle of identification of peaks in the color histogram of the satellite image. The identified peaks are considered as initial seed or clusters. These seeds are then applied to the KMC algorithm to perform the final segmentation. The combined approach of HC and KMC had provided the best result for less complexity images.

Index Terms*: *Segmentation, Hill Climbing, K-Means Clustering, Optimization

I. INTRODUCTION

Color is the most precious aspect in the analysis of image segmentation or information retrieval. Our eye can discriminate only a maximum of 24 intensity (gray) levels in a complex scene due to its brightness adaptation. At the same time, it can distinguish thousands of intensities and shades of color information. This means that segmentation performed on color attribute presents much more significant information as compared to gray scale or binary segmentation. As per the literature survey, most of the image segmentation works have been done in RGB color space. However, the color intensity information is highly correlated in RGB. So it is very difficult to extract the necessary information from RGB color images. This is the main reason why many authors have employed different color space for the image segmentation and information retrieval [5]. They have proposed segmentation in color space other than RGB and some of them have investigated the segmentation using either more than one color model or a combination of color models. In this work, RGB image is transformed into CIELch space for the efficient extraction of the hidden treasure in the images. The combined approach of local optimization search technique, HC and KMC is also applied for the segmentation of synthetic fiber images. This color histogram based technique works on the principle of identification of peaks in the color histogram of the synthetic fiber images. The identified peaks are considered as initial seed or clusters. These seeds are then applied to the modified KMC algorithm to perform the final segmentation. The combined approach of HC and KMC had provided the best result for less complexity images.

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II. PROPOSED APPROACH

The HC is the frequently used local optimization approach for deciphering the intricate issues or problems. This memory competent algorithm produces excellent result even at the cost of less memory. In this, the evaluation function is continuously evaluating the present status of the problem till the convergence is achieved [1]. For instance, a typical objective function has 1D array values. It will fine-tune randomly selected element in X at all iteration and furthermore computes the modification to develop the value of the given function. This iterative procedure is repeated till convergence i.e., no further modification in the function [2]. If the algorithm starts with a poor location, the algorithm may be converging to the undesirable solution i.e., local maximum. K-means clustering is an iterative and unsupervised procedure to cluster an image. It is done by lessen the detachment between a pixel and its centroid. If the number of data is very few and when the same data is applied as input in different ways may produce different clusters. The principle of KMC is based on diminishing its objective function as

$$J = \sum_{j=1}^{k} \sum_{i=1}^{n} \left\| x_i^{(j)} - c_j \right\|^2 \qquad (1)$$

The detailed step by step procedure for the proposed approach is elucidated as follows.

Step 1: Test image (RGB) from database.
Step 2: RGB image is transformed into CIELch space for the efficient extraction of the hidden treasure in the images.
Step 3: Identification of peaks in the color histogram of the synthetic fiber images
Step 4: identified peaks are considered as initial seed or clusters. These seeds are then applied to the modified KMC algorithm to perform the final segmentation [3].

Step 5: HC method formulates a mounting task in the direction of that adjacent bin [4].

Step 6: The procedure enlightened in the preceding step is carried on till the entire non zero bins are mounted. Now every peak is considered as primary seeds.

Step 7: These seeds are then applied to the modified KMC algorithm to perform the final segmentation.

Figure 1 illustrates the flow diagram of the combined approach of HC and KMC for image segmentation. . In this work, RGB image is transformed into CIELch space for the efficient extraction of the hidden treasure in the images.

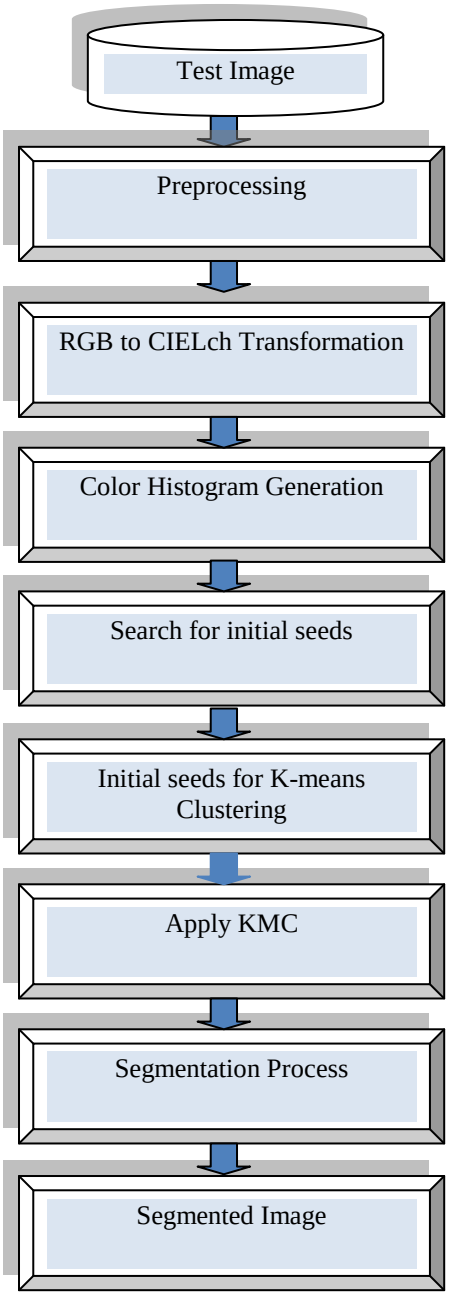

Fig.1. Flow diagram of the combined approach of HC and KMC for image segmentation

The combined approach of local optimization search technique (HC) and KMC is also applied for the segmentation of synthetic fiber images. This color histogram based technique works on the principle of identification of peaks in the color histogram of the synthetic fiber images. The identified peaks are considered as initial seeds or clusters. The seeds then applied to KMC to perform the final segmentation. The combined approach of HC and KMC had provided the best result for less complexity images.

III. EXPERIMENTAL RESULTS

The competency of the proposed approach is investigated with a set of synthetic fiber images. The experimental result for the image1 is illustrated in fig 2.

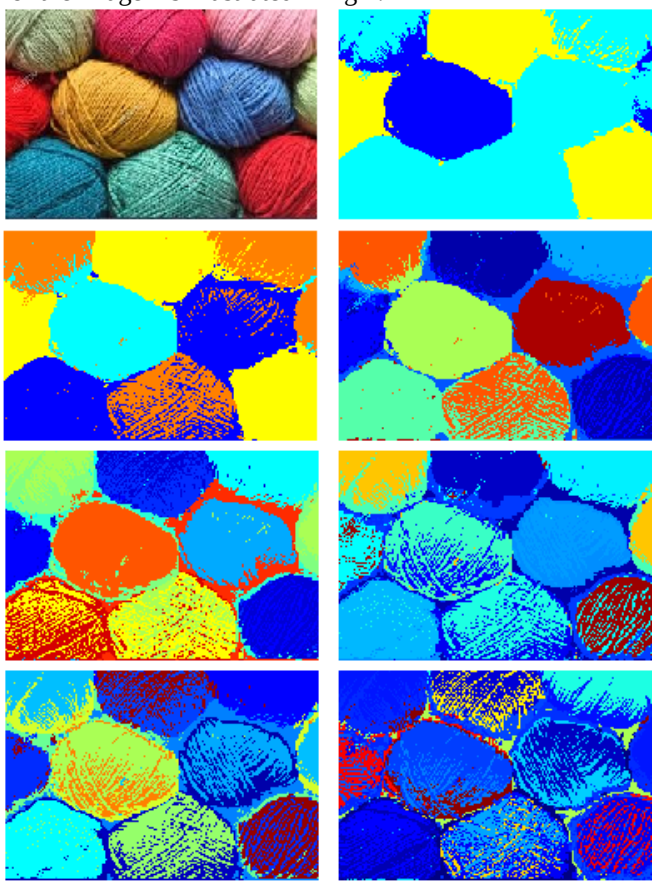

Fig.2. Result of the suggested approach for image1

The experimental result of the proposed method of segmentation of synthetic fiber images (image1 and image2) using the combined approach of HC and KMC is clearly depicted in table 1.

Table 1. Segmentation result for image1

No. of Bins	Primary Seeds	Computational Cost (in sec)
5	3	1.03
10	6	3.16
15	12	4.57
20	26	14.63
25	59	22.49
30	88	33.38
40	242	128.31

The pictorial representation of the impact of number of seeds presented by hill climbing optimization method is shown in fig 3.

This clearly indicates that number of seeds produced is

directly relative to histogram bins.

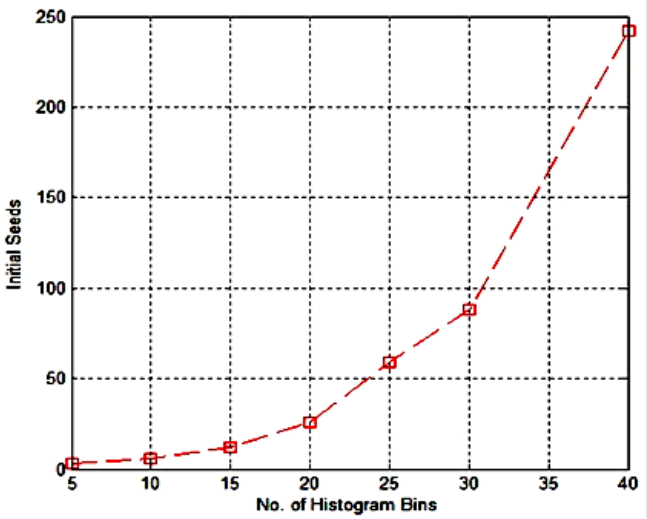

Fig.3. The relationship between histogram bins and initial seeds

The impact of computational cost is clearly illustrated in fig 4. This evidently signified that number of seeds produced is directly proportional to the computational cost.

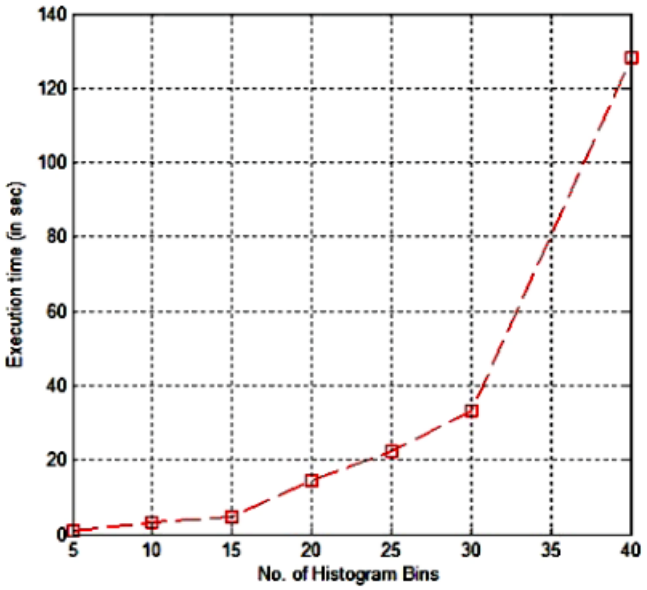

Fig.4. The relationship between number of histogram bins and computational cost

The competency of the proposed approach is investigated with a set of synthetic fiber images. The experimental result for the image1 is illustrated in fig 5.

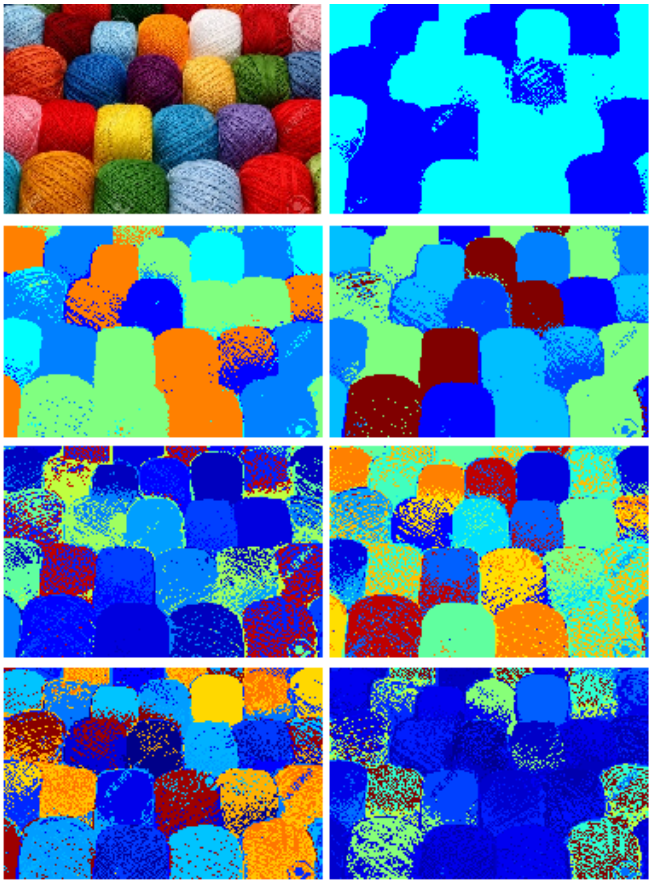

Fig.5. Result of the recommended approach for image2

The experimental result of the proposed method of segmentation of synthetic fiber images (image1 and image2) using the combined approach of HC and KMC is clearly depicted in table 2.

Table 2. Segmentation result for image2 using proposed approach

No. of Histogram Bins	Initial Seeds	Execution time (in sec)
5	3	1.12
10	6	3.40
15	19	7.54
20	34	21.33
25	59	24.32
30	98	47.59
40	218	153.01

The pictorial representation of the impact of number of seeds presented by hill climbing optimization method is shown in fig 6. This clearly indicates that number of seeds produced is directly proportional to the number of histogram bins. The variation of computational cost is clearly illustrated in fig 7. This evidently signified that number of seeds produced is directly proportional to the computational cost.

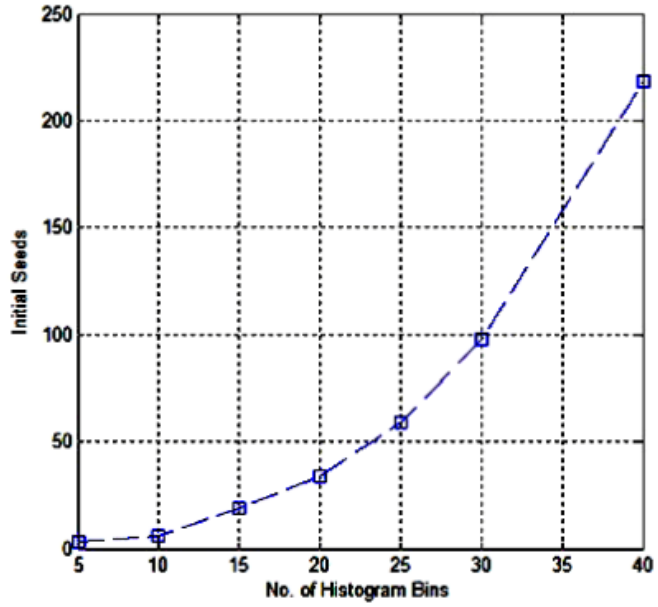

Fig.6. The correlation between histogram bins and initial seeds

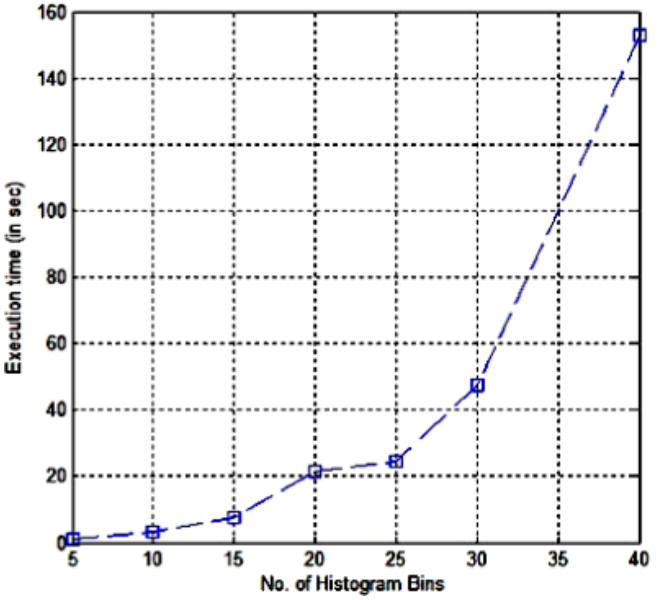

Fig.7. The association between histogram bins and computational cost

IV. CONCLUSION

The synthetic fiber color image segmentation using the two-way approach of local optimization (HC) and clustering (KMC) is explained. RGB image is transformed into CIELch space for the efficient extraction of the hidden treasure in the synthetic fiber images. HC is applied to select the initial seeds for the combined process. This color histogram based technique worked on the principle of identification of peaks from the histogram of the synthetic fiber image. The identified peaks are considered as initial seed or clusters. These seeds are then applied to KMC to perform the final segmentation. The investigational outcome clearly exposed the effectiveness of the combined approach of HC and KMC which provided the best segmentation result for the less complexity images.

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