

Conversion of Three Plane into Single Plane Using MATLAB

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ABSTRACT: The paper present the new method called Fractal Hierarchical colour block coding(FHCBC) which convert three plane of colour image into single plane of the same colour image by making the correlation among them. By using this method we divide the image hierarchically into blocks.for each such block, the variance of pixels' trichromatic coefficients is within a certain threshold value. Then for each block mean and variance will be calculated by the used formula. Then single image is composed and compressed by using fractal coding. After this decoding process is applied for reconstructing the image by applying the decoding algorithm. In this paper this method is compared with SFC(Separated Fractal Coding), the suggested method give better performance in case of gains in running time, high compression ratio and good reconstruction quality.

KEYWORDS: Three Plane of colour image, Matlab coding, Fractal Hierarchical colour block Design.

I. INTRODUCTION

Now days the image compression has become an important topic for storage of information and transformation stored data. This method is useful because firstly we are converting the plane of image and at the same time we are compressing it. The main point of this method is its reconstructed image which is approximately same as the original image. Fractal image coding has its roots in the mathematical theory of iterated function system (IFS) developed by Barnsley while the first fully automated algorithm was developed by Jacquin [1].

The fractal word means that when the single image copy is made several times. A fractal is a geometric figure, often characterized as being "self similar irregular, fragmented or loosely connected in appearance. Fractal provides good variety of shapes of images. And also give the high accuracy. Fractal coding is best suited for natural images, relying on the fact that parts of an image often resemble other parts of the same image. Fractal algorithms convert these parts into mathematical data called "fractal codes" which are used to recreate the encoded image.

Up to now the image compression is mainly done with grey level images. Only rare case is there in which the image compression done with colour image by taking all the three images together. However we now days encounter many colours image than grey image. Every colour image is consisting of three plane RGB plane. In this paper the three plane of colour image is firstly separated then converted into single plane by using the FHCBC algorithm. In method Separated Fractal Coding (SFC) we have to compress each plane separately and this method is much time consuming in comparison to Fractal Hierarchical Color Block Coding (FHCBC) method. This method Separated Fractal Coding (SFC), however, does not exploit the correlation among color components In this paper we have introduce a new method FHCBC (Fractal Hierarchical colour block coding) in which three plane of colour image is converted into signal plane. In this method the image is hierarchical divide into the small block. After this the trichromatic coefficients are calculated by using equation used in algorithm. In this method only single plane need to be coded other remaining two planes will automatically get reconstructed from the encoded one.

This paper is organized as follows: Section II reviews the general block diagram. Section III a classical algorithm of the FHCBC coding and decoding. Section IV introduces the mathematical equation used in FHCBC algorithm and in the next one, experimental results.

II. BLOCK DIAGRAM

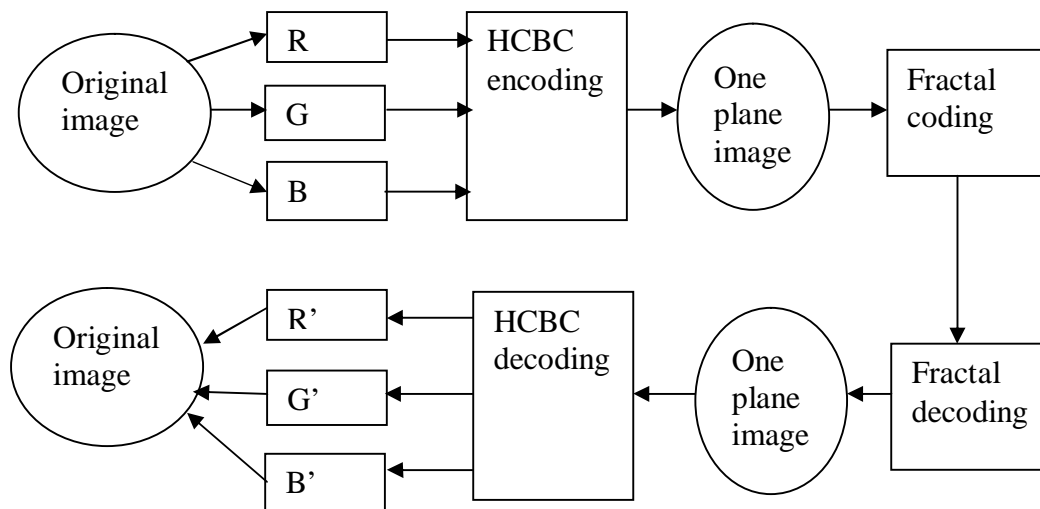


Fig.1 Block Diagram of FHCBC

At the encoding side the block diagram generally explains that takes the color image of size $N \times N$ and then separates its primary color plane red plane, green plane, blue plane. After this apply the HCBC algorithm on them. And convert them into single component color image. Then fractal encoding is applied to single component colour plane.

At the decoding side, after fractal decoding is applied to the obtained single component color image say S' where S' will be equal to S . Then, HCBC is used to restore three color planes by utilizing S'' and mean values of trichromatic coefficients that were previously memorized Then on this single component color image the HCBC decoding algorithm is applied and convert that single component color image again into three primary colors of color image i.e. red plane, green plane, blue plane. And again these three planes are combining to get the original image. At the decoding process, fractal coding algorithm is first applied to get a one-color plane image, say S' , where

$$S' = S.$$

Then, HCBC is invoked to restore the three-color planes by utilizing S' and the mean values of trichromatic coefficients previously memorized.

III. STEPS FOR FRACTAL HIERARCHICAL COLOUR BLOCK CODING ALGORITHM FOR ENCODING-DECODING

The steps of fractal hierarchical color block coding for encoding are as follows

Step-1 Read the color image with size say $N \times N$

Step-2 Calculate the trichromatic coefficients for each pixel using the given equation.

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Step-3 Decompose the image recursively by quad tree partitioning

Further steps involved in step-3 are as follows

Step-A Partition the image in four non overlapped block with size of $N/2 \times N/2$

Step-B For each such block, calculate the average trichromatic coefficients and variances according to the equation given for encoding algorithm.

Step-C The process of division will continue until the given equation is not satisfied. When this occurs, the block will be again further divided into another quadrant sub blocks and for each of them the same process of calculation of mean and variance will repeat again. The process of quarter will be halts if anyone of the two conditions are satisfied.

Condition 1: The pre defined maximum dividing level is reached.

Condition 2: Or given equation is satisfied.

$$V_X^L \leq \text{tol} \quad \text{and} \quad V_Y^L \leq \text{tol} \quad \text{and} \quad V_Z^L \leq \text{tol}$$

Where tol is tolerance

Step-4 By using equation the new image S will be produce with a value of S_{ij} associate to each pixel. The image S and the mean value of trichromatic coefficient ratio of each block are stores as a first block of compressed image.

Step-5 Use fractal decoding algorithm to compress the composite image S. Store the affine transformations as the second part of compressed image.

The steps of fractal hierarchical color block coding for decoding are as follows

Step-1 Use the fractal decoding algorithm and second part of compressed image to decode image S'
where

S' will be equal to S.

Step-2 Use given equation and first part of compressed image to get the primary component of color image which were equal to the primary color component of original image.

Steps-3 Again use this obtained primary color component to reconstruction the image which will be same as original image.

IV. MATHEMATICAL EQUATION USED IN FHCBC ALGORITHM

The mathematical equations used in FHCBC algorithm are as follows

1. The Trichromatic equations are

$$X_{ij} = R_{ij} / R_{ij} + G_{ij} + B_{ij}$$

$$Y_{ij} = G_{ij} / R_{ij} + G_{ij} + B_{ij}$$

$$Z_{ij} = B_{ij} / R_{ij} + G_{ij} + B_{ij}$$

Where X_{ij} , Y_{ij} , Z_{ij} are called the trichromatic coefficients of pixel (i,j) which describe the percentage of each color component in their sum. And R_{ij} , G_{ij} , B_{ij} represents the red, green, blue component of pixel (i,j) respectively.

2. The mean equation

$$M_X^L = 1/m^2 \sum_{i=Lx}^{m+Lx} \sum_{i=Ly}^{m+Ly} X_{ij}$$

$$M_Y^L = 1/m^2 \sum_{i=Lx}^{m+Lx} \sum_{j=Ly}^{m+Ly} Y_{ij}$$

$$M_Z^L = 1/m^2 \sum_{i=Lx}^{m+Lx} \sum_{j=Ly}^{m+Ly} Z_{ij}$$

Where, M_X^L, M_Y^L, M_Z^L represents the mean value of trichromatic coefficients X, Y, Z on block L, respectively. Where m is block size and Lx, Ly are x and y coordinates of the first pixel of block L.

3. The variance equation

$$V_X^L = 1/m^2 \sum_{i=Lx}^{m+Lx} \sum_{j=Ly}^{m+Ly} |X_{ij} - M_X^L|^2$$

$$V_Y^L = 1/m^2 \sum_{i=Lx}^{m+Lx} \sum_{j=Ly}^{m+Ly} |Y_{ij} - M_Y^L|^2$$

$$V_Z^L = 1/m^2 \sum_{i=Lx}^{m+Lx} \sum_{j=Ly}^{m+Ly} |Z_{ij} - M_Z^L|^2$$

Where V_X^L, V_Y^L, V_Z^L represent the variance of trichromatic coefficients X, Y, Z on block L respectively. where m block size and Lx, Ly are x and y coordinates of the first pixel of block L.

4. The tolerance equation

$$V_X^L \leq \text{tol} \quad \text{and} \quad V_Y^L \leq \text{tol} \quad \text{and} \quad V_Z^L \leq \text{tol}$$

5. Equation to composite the single image

$$S_{ij} = R_{ij} X_{ij} + G_{ij} Y_{ij} + B_{ij} Z_{ij}$$

Where S_{ij} represent the composite image and X_{ij}, Y_{ij}, Z_{ij} are trichromatic equation .

6. The equation for decoding the FHCBC algorithm

$$R_{ij}' = [M_R^L / (M_R^L)^2 + (M_G^L)^2 + (M_B^L)^2] * S_{ij}'$$

$$G_{ij}' = [M_G^L / (M_R^L)^2 + (M_G^L)^2 + (M_B^L)^2] * S_{ij}'$$

$$B_{ij}' = [M_B^L / (M_R^L)^2 + (M_G^L)^2 + (M_B^L)^2] * S_{ij}'$$

Where $R_{ij}' \approx R_{ij}, G_{ij}' \approx G_{ij}, B_{ij}' \approx B_{ij}, S_{ij}' \approx S_{ij}$ and R_{ij}', G_{ij}' and B_{ij}' are red, green, blue component of pixel(i,j) result

V. EXPERIMENTAL RESULT



Fig.2 Conversion of three plane into single (a)Original image (b)seperated Red plane (c)seperated Green plane (d) seperated Blue plane

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The above fig. shows the results for separated planes of original image. Fig(a) shows the original image that is taken for experiment. Fig(b) shows the separated red plane of original image. Fig(c) shows the separated green plane of original image. Fig(d) shows the separated blue plane of original image. The matrix values of these images has been taken to find out trichromatic equations. Which is then used for calculating means and variance according to the equations.



Fig.3 (e)Combination of RGB plane after finding mean and variance (f)Final image similar as original image

The above fig (e) shows the composite single image that has been obtained by using the trichromatic matrix and the separated plane matrix of the original image. The fig (f) shows the final image that has been obtained by using the matrix of fig (e). This image further can be used for compression.

VI. CONCLUSION

In this paper we have implemented Fractal Hierarchical colour block coding algorithm for both coding and decoding for an image. Our algorithm successfully converted the three plane of colour image into a single plane. And further we can use this plane for compression. Main advantage of this algorithm is that we need not to compress all three planes of the image and we can save our transmission time.

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