Performance Analysis of medical Image Using Fractal Image Compression

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Abstract

Fractal Image Compression is a new technique in image compression field by using a contractive transform for which the fixed points are closed to that of original image. This broad field incorporates in itself a very large numbers of coding schemes, which have been published after being explored in this field. The paper gives and introduction and experimental results on Image Coding based on Fractals and different techniques used that can be used for the image compression.

Keywords

Fractals, image compression, iterated function system, image encoding, fractal theory

I.   INTRODUCTION

With the advance of the technology the need for mass storage and fast communication links is required. Storing images in less memory leads to a direct reduction in storage cost and faster data transmissions. Images are stored on computers as collections of bits representing pixels or points forming the picture elements. It has been known that the human eye can process large amounts of information (some 8 million bits), so many images are required to be stored in small sizes. Most data contains some amount of redundancy, which can be removed for storage and retained for recovery, but this does not lead to high compression ratios. So in Image compression techniques the no of bits required to store or transmit images is reduced without any appreciable loss of the data. The standard methods of image compression come in several varieties. The current most used method relies on eliminating high frequency components of the signal by storing only the low frequency components (Discrete Cosine Transform Algorithm).This method is used on JPEG (still images), MPEG (motion video images), and H.261(Video Telephony on ISDN lines) compression algorithms.

The other technique is fractal compression. This technique seeks to exploit affine redundancy present in the typical images in order to achieve higher compression ratios as well as maintaining good image quality. In this, the image is divided into non- overlapping range blocks and overlapping domain blocks where the dimensions of domain blocks is greater. Then for each the most similar domain block is found using the mean square error(MSE).

The paper is organized as follows. Section 2 briefs about the fractal image compression method. Section 3 explains the fractal image compression technique Iterated Function systems. Section 4 derives the conclusion.

II. Fractal Image Compression

1. Fractals

Fractal is a structure made of of a number of patterns and forms that can occur in any different sizes within an image. The term Fractal was used by B. Mandelbrot for describing the repetitive patterns, structures occurring in a image. The observed structures are very similar to each other w.r.t. size, orientation, and rotation or flip.

2. Fractal image compression

Let us imagine a photocopy machine that reduces the size of the image by half and multiplies he image by three times[1]. Fig 1 shows the results of the photocopy machine.

Now fed the out put back into the machine as input. We will observe that the copies are converging as in fig 2. This image is called as attractor image because any initial image will converge to that image in repeated running. This describes that the transformations are contractive in nature i.e. if the transformation is applied to two point of any image, it must bring them together.

In practice chosen transformation is of the form

$$W\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} A & B \\ C & D \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} + \begin{bmatrix} E \\ F \end{bmatrix}$$

Where A=rotation; B, C=magnitude; D=scaling parameters.

E, F= parameter causing a linear translation of point being operated upon.
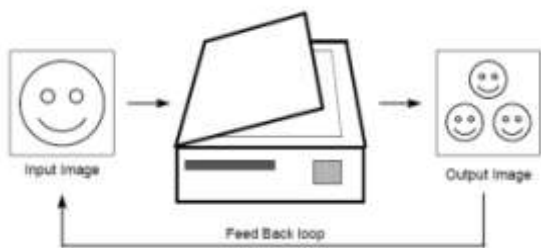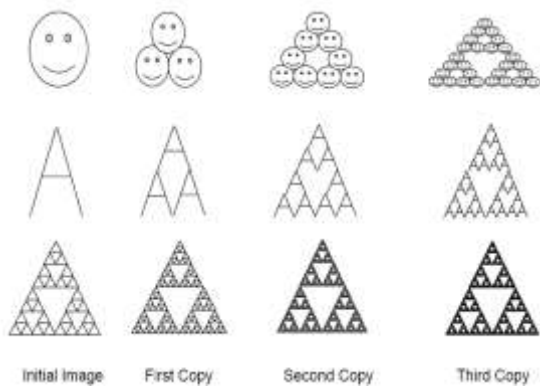

Fig 1: A copy machine making reduced copies

Fig 2: first three copies generated by copying machine.

3. Contractive Transform

Any transform is said to b contractive if for any two point P1,P2, the distance

D(w(P1),w(P2))<sd(P1,P2)

for some s<1, where d=distance.

This contractive map will always brings points together.

4. Partitioned iterated function system

A iterated function system is a collection of affine transforms w_1, w_2------------, w_n. where W is applied to the input image.

A Partitioned IFS (PIFS) is nothing but IFS where the transforms are restricted to operate on specific subset of the input image, domain blocks. Now applying the transform to the domain blocks results in a range blocks. First and foremost an IFS will not work for any simple image as it is based on self- similarity present in the image and its parts. In order to fractally compress an image, we have to identify the self similarity in input image, so that we can express it in a set of transform.

In order to map a source image onto a desired image using iterated function system, more than one transformation is often required and each transform has its relative importance with respect to another transform.

5. Algorithm for fractal image compression/ methodology used

1. Load a input image.
2. Cover/partition the input image into square range blocks without overlapping (as range blocks).
3. Introduce the domain block, the size of the Domain block to be twice the size of the range block.
4. Compute the fractal transform for each block.

5. For each range block, choose a domain block that resembles it with respect to symmetry and looks most like the range block.

6. Compute the encoding parameters that satisfy the mapping.

7. Write out the compressed data in form of local IFS code (as code book).

8. Apply any of the lossless data compression algorithms to obtain a compressed image.

The major problem with the fractal based coding is that the encoder is very complex.

The complexity is due to the image block processing required for range and domain blocks. Also much computation is also required in the mapping process of the range and domain block.

So, one the most expressing feature of the fractal image compression is that its decoding process in very simple and easy.

The decoder does its work exactly the same way as the fixed block encoder. The decoder consumes much less time than the conventional methods. The decoding time here generally depends on the number of iterations performed by the decoder and in this compression technique a fewer number of iterations ranging from 3-5 to reach the fixed point encoding are required.

III.   Results
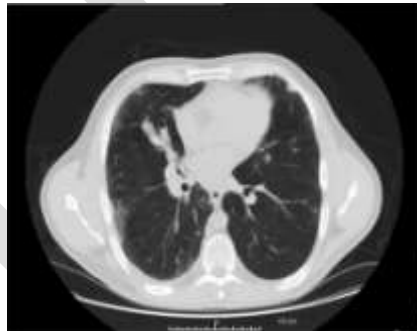
a) Test and result images

Fig 3 input image (chest CT scan)

Fig 4 block processed image 4*4

Fig 5 Domain block 8*8

Fig 6 mapped image of 4*4 and 8*8

b) Performance

image	PSNR Value for threshold TH=0.1	
	1)	23.26
	2)	23.27
	3)	23.255
	Average	23.26

Table 1 PSNR value at threshold 0.1

Parameter	4*4	8*8	Transformed image
RMS	.7291	.7291	.7291
MEAN	.3371	.3401	.3401
SD	.3273	.3272	.3272

Table 2 values of modalities using differ blocks results

The derived results are expected ones. The table 1 shows the PSNR value of the entire system used for image processing. With these values of PSNR we obtained a good compression rate and large gains. Table 2 shows the different parameters obtained for different intermediate results. The matched image shows the non redundant or useful data in our image that can be used for decision making.

IV.   Conclusion

This field fractal image compression is new.

There is no standardized approach to this technique. The main concept in this compression scheme is to use the IFS to reproduce images. By partitioning any image into [8 8], [16 16] pixels, the smaller portions are reproduced by fractal transformation. The speed up in the decoding time via the use of the fractal image compression should be considered as an interesting technology.

It is evitable that there are many applications where the fractal nature of the image can be used for computational purposes.

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