A NEW METHOD OF NEURAL NETWORK BASED FAST FRACTAL IMAGE COMPRESSION

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Abstract: **Fractal compression is a loss compression method for digital images, based on fractals. The method is best suited for textures and natural images, relying on the fact that parts of an image often resemble other parts of the same image. Fractal Image Compression (FIC) techniques take more time to perform processes are encoding and global search. Many different researchers and companies are trying to develop a new algorithm to reach shorter encoding time and smaller files. But there are still some problems with fractal compression. Fractal image compression is promising both theoretically and practically. The encoding speed of the traditional full search method is a key factor rendering the fractal image compression unsuitable for real-time application. The primary objective of this paper is to investigate the comprehensive coverage of the principles and techniques of fractal image compression. The experimental result shows that the application of the designed hybrid image compression method can increase the signal-to-noise ratio of an image while the high compression ratio of the image is guaranteed.**

Keywords- **Contractive transform, domain classification and feature vector, Partial discharge image, pattern recognition, fractal image compression.**

I. INTRODUCTION

Though there are many kinds of image encoding method, the characteristics of compression effect the compression ratio and the time duration of encoding and decoding of traditional encoding method, M. Barnsley introduced the fundamental principle of fractal image compression in 1988 [2]. Fractal theories are totally different from the others. Fractal image compression is also called as fractal image encoding because compressed image is represented by contractive transforms and mathematical functions required for reconstruction of original image, instead of any data in pixel form. Contractive transform ensures that, the distance between any two points on transformed image will be less then the distance of same points on the original image [2]. These transforms are composed of the union of a number of affine mappings on the entire image, known as iterated function system (IFS) [1], [2]. Barsnley has derived a special form of the Contractive Mapping Transform (CMT) applied to IFS's called the College Theorem [1, 2]. The usual approach of fractal image compression is based on the college theorem, which provides distance between the image to be encoded and the fixed point of a transform, in terms of the distance between the transformed image and the image itself. This distance is known as college error and it should be as small as possible. A.E. Jacquin gave first publication on Fractal image compression with partitioned IFS (PIFS) in 1990 [1], [4], [5]. In Jacquin's method the image is partitioned in sub images called as 'Range blocks' and PIFS are applied on sub-images, rather than the entire image. Locating the range blocks on their respective position in image itself forms the entire image. Temporary images used to form range blocks are known as domain blocks. The overall process of fractal image encoding includes four levels of decision-making. A wide variety of methods have been suggested for every level. For a given degree of image compression we get moderately better signal to noise ratios to get good image quality in retrieved image. Medical Image compression using fractal concept would tend to arrive at higher compression rates and fractal zooming further allows us to increase the size of the image however the loss of information in fractal compression is unacceptable in medical imaging. Lengthy encoding process is another drawback of fractal compression as it leads to increase in computational encoding complexity. This paper addresses to above mentioned issues of fractal image compression.

II. STANDARD FRACTAL IMAGE COMPRESSION METHOD

A two dimensional image is represented mathematically as z= f(x, y) where f(x, y) represents the gray level with 0 being black and 1 being white at the point (x,y) in an image. I denote the close Interval [0 1] .On applying transformation 'W', on to the image 'f', we get a transformed Image W(f).W always moves points closer together as it is contractive. Affine transformations are combinations of rotations, scaling and translations of the coordinate axes in n-dimensional space which always map squares to parallelograms. The general form of affine transformation is given by

$$W=\begin{bmatrix}x\\y\end{bmatrix}=\begin{bmatrix}a & b\\c & d\end{bmatrix}\begin{bmatrix}x\\y\end{bmatrix}+\begin{bmatrix}e\\f\end{bmatrix}=\begin{bmatrix}ax+by+e\\cx+dy+f\end{bmatrix}$$

---- (1)

If the translations (e & f), scaling factors(r & s) and rotations (θ & φ) are known in advance, then the coefficients may be calculated. The transformation found suitable for encoding gray scale images thought of as a three dimensional image with coordinates as x & y and intensity as z is given in equation 2 where si controls the contrast and oi controls the brightness of transformation.

$$w_i\begin{bmatrix}x\\y\\z\end{bmatrix}=\begin{bmatrix}ai & bi & 0\\ci & di & 0\\0 & 0 & si\end{bmatrix}\begin{bmatrix}x\\y\\z\end{bmatrix}+\begin{bmatrix}ei\\fi\\oi\end{bmatrix}$$

-----(2)

An image is encoded as the attractor of an iterated function system in fractal compression. The observation "Natural images are partially self transformable" forms the basis for image encoding. They possess „affine redundancy" in the aspect that a block in the image (called range) can be derived from another block of the same image (called domain) by some affine transformation. On encoding, the image is represented as the union of best-fitting affine transformation and the equivalent image domain blocks for all segments satisfying of the image support. In every fractal encoding method, the encoding process begins with division of the image into a set of non-overlapping segments(range blocks), followed by the search for an image block (domain block) with different resolutions that gives the best affine mapping to the range segment for each range block. Compression is accomplished by encoding the domain and the affine transformation for each range block [9].

III. IMAGE QUALITY ASSESSMENT

Image Quality Assessment in Image Processing plays an important role, as image processing algorithms and systems design benchmarks to help assess the best or the quality of the results. At present more commonly used by the image quality index for the assessment of Mean Square Error (MSE) and the Peak Signal to Noise Ratio (PSNR), respectively, are defined as follows:

$$MSE=\frac{1}{N}\sum_{i=1}^{N}(x_i-y_i)^2$$

-----(3)

$$PSNR=10\times log\frac{255^2}{MSE}$$

------(4)

where N is the size of image, xi and yi are the gray level of pixel of original image and test image However, these common approach, focused on the image gray value of the mathematical model to quantify the numerical standards, although with an objective assessment, but not all of the assessment results can meet the human visual judgement. By Figure 1 can be found in the Test Signal 1, Test Signal 2 and Original Signal Error Signal of the MSE results are the same, but the human visual judgement can be found Test Signal 1 is closer to Original Signal.

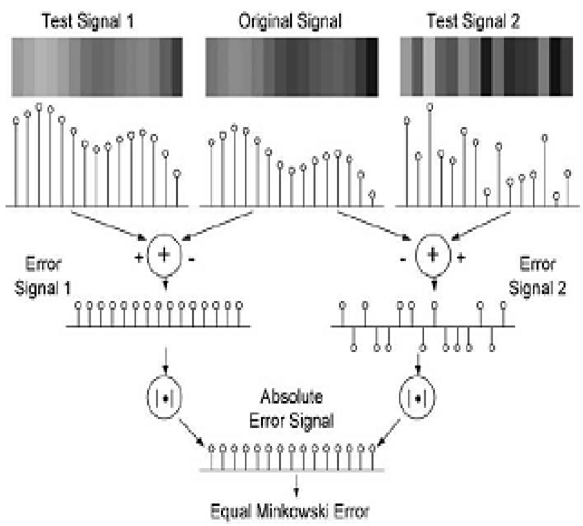

Figure 1. MSE distortion of the signal different

A. Full Search Fractal Image Compression

Fractals are mathematical sets that exhibit self-similarity under all scales of magnification. In fractal image coding an arbitrary image is encoded into a set of equations. These equations are usually affine transformations that transform a sub-image, called a domain block u, into another sub-image, called a range block v. In addition, to be calculated MSE given range block v, to find a domain block u, p and q to make d = kp ¢ u + q ¡ vk minimum, p and q is define as follows:

$$p = \frac{N \times \sum_{i=0}^{N-1} u_i v_i - \sum_{i=0}^{N-1} u_i \sum_{i=0}^{N-1} v_i}{N \times \sum_{i=0}^{N-1} u_i^2 - \left(\sum_{i=0}^{N-1} u_i\right)^2}$$

$$q = \frac{1}{N}\left[\sum_{i=0}^{N-1} v_i - p\sum_{i=0}^{N-1} u_i\right]$$

----(5)

An image is divided into non-overlapping range blocks, and a search for a best matching domain block is performed for each range block. Domain blocks are usually larger than range blocks, and are similar to one another under that affine transformation.

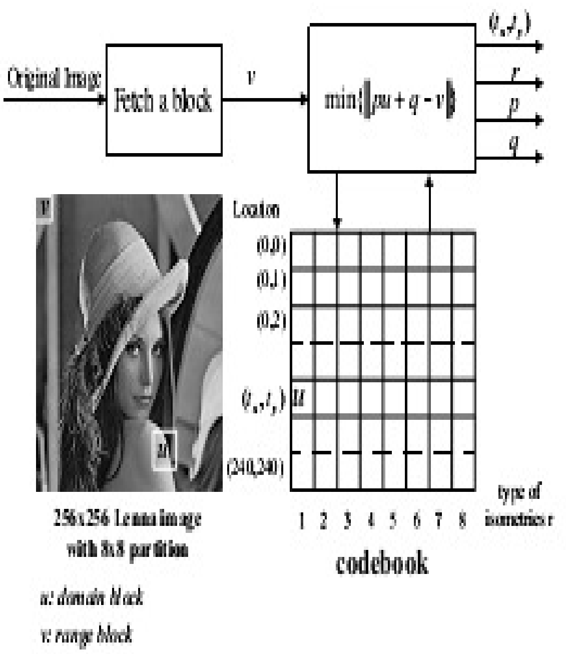

Figure 2. Fractal Image Encoding

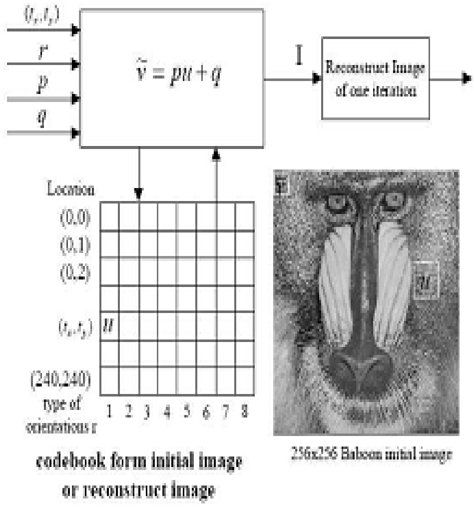

Figure 3. Fractal Image Decoding

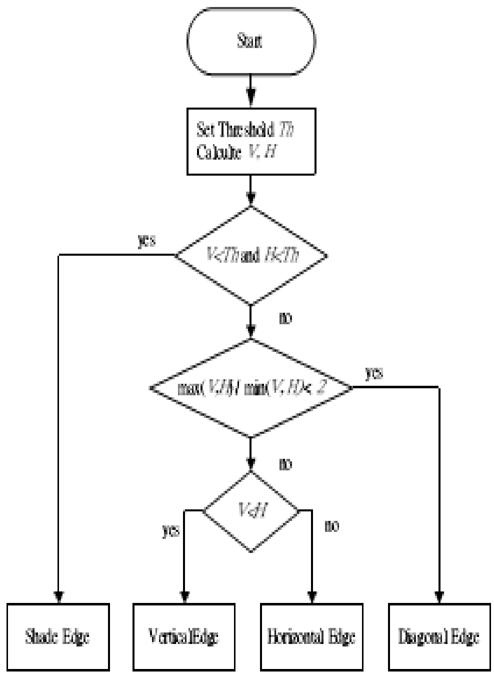

Figure 4. The World flow of Edge Oriented Classification

IV. CONCLUSION

In this paper, the Structure Similarity and block property classifier employed for the fractal image compression is investigated. Experimental results show that the visual effect is better and the encoding speed is 10 times faster than that of the full search Some decoded PD images may not achieve the requirement for recognition even though the compression error is controlled to be small. Considering feature errors and visual qualities of decoded images

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