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Fractal Image Compression with Advanced Particle Swarm Optimization and Sorting

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ABSTRACT

The need for images in our day-today-day life increased drastically. This gives more attention to compression of an image. The image compression focuses on the problem of optimizing storage space and transmission of an image. Research advances in fractal image compression which focuses on computationally efficient and effective algorithm. Fractal compression is an asymmetric process which takes more time to compress an image than decompressing it. It explores the self-similarity property to find the best match within the image itself. In this thesis, an effect is made towards the partitioning methods and coding efficiency in terms of search time. In the existing system, fractal image compression using a genetic algorithm with ranking select mechanism is used. This algorithm is applied on fractal as well as non-fractal images and the result shows that the encoding time for both types of images is greatly reduced while maintaining their quality intact. However, the encoding process is not simple and it fails to maintain other types of images in terms of image quality. In this study, a novel Advanced Particle Swarm Optimization with Sorting based FIC method is proposed, to both speed up the encoding process and retain the quality of the retrieved images. In the proposed algorithm the coefficients of the image are extracted in order to classify the image using DCT. Then according to the coefficients of the range regions the search strategy for each range block is determined by using an algorithm. This proposed algorithm is applied on fractal as well as non-fractal images and the new result shows that the encoding time for both types of images is greatly reduced and also maintaining compression ratio with PSNR value.

Keywords: - Fractal Image Compression, Particle Swarm Optimization, Search encoding, PSNR, Compression Ratio.

I. INTRODUCTION

The purpose of image compression is to decrease irrelevance and redundancy of the image data in order to be able to store or transmit data in a proficient form. Image compression is minimizing the amount in bytes of a graphics file without modifying the quality of the image to an undesirable level. The decrease in file size allows extra images to be stored in a given amount of disk or memory space [1]. In addition, reduces the time necessary for images to be sent over the Internet or downloaded from Web pages. It becomes essential to find efficient representations for digital images in order to decrease the memory required for storage, progress the data access rate from storage devices, and reduce the band- width and/or the time required for transfer. The branch of digital image processing that deals with this problem is called image compression [1] [2]. Image compression is concerned with minimizing the number of bits required to represent an image.

A. Need for Image compression

Digital images are extremely large in size and therefore engage larger storage space. Due to their outsized size, they take improved bandwidth and more time for upload or download all over the Internet [3]. This makes it challenging for storage as well as file sharing. To challenge with this problem, the images are compressed in size with particular techniques. This compression not only supports in reduction of storage space but also enables easy sharing of files. Image compression applications decrease the size of an image file without causing key degradation to the quality of the image.

B. Types of Image compression

Image compression makes use of a selection of techniques and algorithms in compressing images. The method of compression used depends on the required quality of output. There are two main module of image compression:

- Lossless image compression
- Lossy image compression

If the image compression application is usual to produce a very high-quality output without any loss in dependability, lossless compression procedure is used. This method is used where a high degree of accuracy is a must. In this process where some importance can be compromised, a lossy compression method is used. In lossy compression, there is a tiny loss of quality, but the loss is too unassuming to be visible. This technique is used in applications where a little compromise on a superiority of image is acceptable.

C. Overview of Fractal Image Compression

Fractal image compression is a new technique and has previously received a great deal of consideration. The most significant advantages of fractal image compression are:

High renovation quality at low coding rates, rapid decoding, declaration independence i.e.; an encoded image may be decoded at an advanced resolution than the original. Fractal image compression allows quick decoding, but encoding is very slow. The qualities and drawbacks of fractal image compression in comparison to JPEG and other methods. Fractal image compression is based on the examination that real-world descriptions in general are rich in affine redundancy. The larger blocks (domain blocks) of the image seem like smaller blocks (range blocks) in the corresponding image. The encoding practice consists of finding a transformation for every range block with domain block, which fits greatest in the intelligence of the used image metric. These affine maps give a compacted representation of the original image and are used to redevelop that image, usually with some quantity of loss.

Fractal image compression is based on the concepts and numerical grades of iterated function systems (IFS) [3]. Several researchers have taken up deals with to design a mechanical algorithm to solve the opposite difficulty using the basic IFS method and its generalizations [3]. In a way, the work by Jacquin and his succeeding papers broke the ice for fractal image compression as extended as a starting point for further research and extensions in many feasible directions.

1. The partitioning of the image into ranges blocks.

2. Encoding: Choice of the domain pool, together with several fixed basis blocks and even several image domain blocks for the code of a range, choice of the transformations major the operator.

3. Classification methods for the complexity decrease of the encoding step: based on image values and amount variance, clustering of domains, fast algorithms from computational geometry to solve adjacent neighbour problems [3].

4. The decoding pattern iteration versus fast hierarchical or direct numerical.

A much large quantity of storage space, large transmission bandwidths and long transmission times are necessary for image transmission. Therefore to rebuild the image, it is more essential to compress the image by storing only the significant information in it. The use of the image compression is to store a lot of images in the given amount of disk. It also reduces the time required for the imagery to send. This method is well appropriate for digital images that have been based on fractals. The main advantage of fractal image compression is its good image quality. Due to its good image quality, it has been used in a variety of applications including characteristic extraction, image watermarking and motion compensation in video coding. Although fractal image compression has a range of advantages and used in many applications, it stills have some disadvantages. The disadvantage is that the fractal image compression consumes a little bit of time to complete the entire process. So in order to speed up the fractal image compression, a lot of speedup techniques are introduced earlier to overcome the problem, but it still needs a better performance. Therefore this research work aims at improving the fractal image compression technique performance.

Research advances in fractal theory have created a surge of interest in applications like image compression [4] [6]. The examination and design of computationally resourceful and effective software algorithms for lossy and lossless image compression forms the main purpose of this thesis. In fractal image compression, parts of an image is described with mention to other parts of the same image and, by doing so, the redundancy of piecewise self-similarity is exploited. There are a number of efforts to be solved in fractal image compression to make the process feasible and more efficient.

The work reported is aimed at early computationally efficient and effective image compression algorithms using fractal techniques. The work is particularly determined towards fractal image compression with an idea to decrease the computational requirements to achieve good copy of image quality. In this direction the following methods are developed.DCT coefficient based classification with parallel execution is used in fractal image compression which increase up the encoding step in fractal image compression. Advanced Particle Swarm Optimization with sorting mechanism (APSOS) is used to be providing efficient searching for approximations to total optima in large and composite spaces in relatively short time.

II. DCT COEFFICIENT BASED CLASSIFICATION WITH PARALLEL EXECUTION

To advance the fractal encoding speed, this paper proposes a new block classification method based on the coefficient characteristics of image pixels. The importance of this method is that if the domain block has the same edge trait to the range block then they are similar in fractal meanings. By limit the exploiting coefficient range of domain block, this method can not only fasten the fractal encoding speed, but also assurance the quality of the decoded image. In this classification method, image blocks classified into image DCT coefficient. Pixel coefficient of an image is calculated and executed parallel. So the encoding time will be reduced.

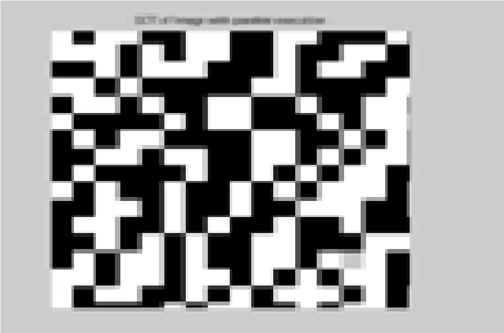

Fig.1 DCT of image

III. IMPLEMENTATION OF ADVANCED PSO WITH SORTING MECHANISM (APSOS)

The fast search strategies using optimization are discussed in this chapter. Here, the fractal image compression is speeded up using Advanced PSO algorithm. The Advanced PSO algorithm used here is to reduce the fractal encoding process. In the APSOS method, the fitness is designed for each particle. If the fitness of the current particle is greater than the previous particle, the position and velocity of the method is updated by using the velocity and particle updated equation, if the maximum iteration or end condition appears, it gives the global best particle. Thus, the APSOS algorithm process is carried out in fractal image compression to increase the encoding process.

Particle swarm optimization (PSO) is a population-based optimization technique, and was proposed by Kennedy and Eberhart in 1995. PSO simulates the social characteristics of organisms, such as bird flocking and fish schooling, to explain a routinely evolving system. In PSO, each exacting candidate solution is "an entity bird of the flock", that is, a particle in the explore space. Each element makes use of its individual memory and information gained by the swarm as a whole to discover the finest solution. All of the particles include fitness values, which are intended by fitness function to be optimized, and have velocities which direct the company of the particles. Throughout association, each particle adjusts its position according to its own practice, as well as according to the knowledge of a nearest particle, and makes use of the best location encountered by itself and its neighbour [8]. The particles move throughout the problem space by subsequent a current of optimum particles. The initial swarm is generally shaped in such a way that the population of the particles is spread randomly over the search space. Each particle is modernized by following two "best" values, called *pbest* and *gbest*. Each particle keeps way of its coordinates in the problem space, which are connected with the best solution (fitness) the particle has achieved so far. This condition value is stored, and called *pbest*. When a particle takes the whole population as its neighbour, the finest value is a global "best" value and is called *gbest* value. Both *pbest* and *gbest* values are sorted.

The pseudo code of the Advanced PSO procedure is given below for FIC is as follows;

Step 1: Initialize DCT Coefficient of an image as population

Step 2: While the number of pixel generations with this DCT coefficient, or the stopping criterion is not met

Step 3: For par = 1 to number of particles in image is added.

Step 4: If the fitness of DCT coefficient is greater than the fitness of then Update p best *p*= X *p,* p X p pbest

Step 5: For $k \in$ nearest DCT coefficient of *p X*

Step 6: If the fitness of *k X* is greater than that of *gbest* then Update *gbest* = X *k.*

Step 7: Sort the values of *gbest and Pbest*

Step 8: Repeat the steps through the search process

IV. EXPERIMENTAL RESULTS

The proposed algorithm fractal image compression with Advanced PSO, the encoding time required to compress the image is found to be large while maintaining its PSNR quite good.

TABLE1. RESULT ANALYSIS

METHOD	EXISTING FIC	PROPOSED APSOS
PSNR dB	30.012	56.804
Encoding Time Sec	34.5	23.6
Compression Ratio	16.234	44.342

Fig. 2 Original image of Barbara

Fig. 3 DCT image of Barbara with parallel execution

Fig.4 Decompressed image of Barbara

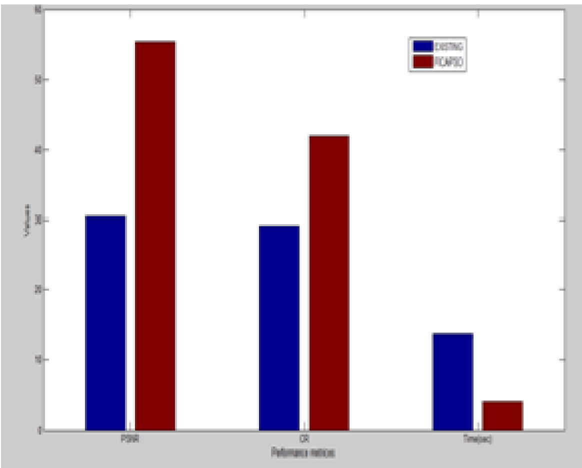

Fig.5 Performance evaluation of the image

V. CONCLUSION

Fractal image compression is an asymmetric lossy compression method which includes lot of computations in it. Due to this computational overhead more time is required for the image to compress. A simple FIC algorithm minimizes this overhead by reducing the computations which ultimately reduces the encoding time, But sometimes it fails to maintain the other parameters at the desired level such as image quality ,PSNR .So a need of another improved technique is been generated. Advanced Particle Swarm Optimization with sorting mechanism with DCT coefficient classification algorithm fulfils this need to a large extent by giving the improved and optimized result for fractal and non- fractal images.

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