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Survey on Optimization of Fractal Image Compression

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Abstract: ***Fractal image compression is a comparatively recent technique based on the representation of an image by a contraceptive transform, on the space of images, for which the fixed period is close to the original image. This review presents a survey of the most significant improvements, both practical and theoretical in the original fractal coding scheme. In this paper, fractal image compression is discussed .It is a lossy compression method for digital images and based on fractals. This method is best suitable for textures and natural images and depends on the fact that parts of an image many times resemble to the other parts of the same image. In this paper, we are comparing two techniques i.e. Fractal image compression and fractal image compression with PBO on the basis of performance parameters i.e Peak signal to noise ratio (PSNR) and Mean Square Error (MSE) of compressed images.***

Keywords: Image Compression, fractals, Lossy Compression techniques, Pollination based optimization (PBO)

1. Introduction

1.1 Image Compression

Image compression is a process by which we can minimizing the size in bytes of images and videos without degrading the quality and it will help us to increase storage and transmission process's performance. The reduction in file size allows more images to be stashed away in a given quantity of magnetic disk or storage space. It also shortens the time required for images to be broadcast over the Internet or downloaded from Web pages. In image compression, we do not only concentrate on reducing size but also concentrate on doing it without losing quality and information of image. Image compression is used to reduce the storage space of images, videos which will help us to increase storage and transmission process's performance. In image compression, we not only concentrate on reducing size but also concentrate on doing it without losing quality and information of image.

1.2 Why we Need Image Compression

We need image compression because images occupies huge amount of memory both in RAM and in storage. It requires huge sizes of the data files, in uncompressed form. In this, the storage devices have comparitively slow access. It also require limited bandwidth of the communication channels.

1.3 Types of Image Compression

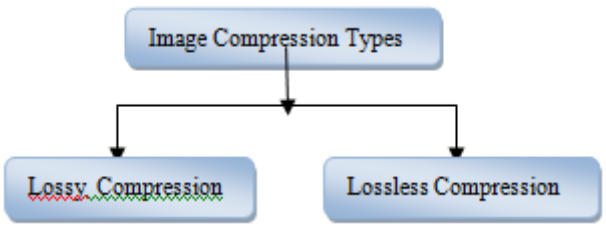

Figure 1: Types of Image Compression

1.3.1 Lossless Compression: Using this, the reconstruct image is same as the original image after compression. It also gives better quality as compare to lossy but less compression.

1.3.2 Lossy Compression: Using this, the rebuilt image can degrade comparative to the original through which image quality degradation in each compression or decompression step. It gives lower quality as compared to first one but high compression.

1.4 Lossy Compression Techniques

- DCT (Discrete cosine transform)
- DWT(Discrete wavelet transform)
- Fractal compression

2. Discrete Cosine Transform

The Discrete Cosine Transform technique is commonly used for image compression. It converts an image into the summation of series of cosine waves at different frequencies. It is same as the DFT but DCT used only cosine functions and real coefficient while DFT used both sine and cosine function and need to use complex numbers. It is very simple for calculation. It divides an image into parts of different frequencies where useless frequencies are removed by quantization and useful frequencies are used to recover the image during decompression. There are of two types:-1-D DCT and 2-D DCT . The one-dimensional DCT is used for processing of 1-dimensional signal. On the other hand, for 2-dimensional DCT, require 2-D version of the DCT.

3. Discrete Wavelet Transform

Firstly we should know about "wavelets". Wavelets are used to transform decomposed signals into set of functions. The Discrete Wavelet Transform is a technique which is used to transform discrete time signal into discrete wavelet

functions. There are of two types: 1-D DWT and 2-D DWT. The two-dimensional transform can be performed by one-dimensional transform. In this , we pass signals from low pass (L) and high pass (H) filter, then eradicated by a factor of 2, which is contain 1 level transform. Divide image into 4 sub-blocks referred to as LL, HL, LH & HH. Further splitting the 4-sub blocks. The inverse wavelet transform is provide by up sampling of all 4 sub-block from factor of 2 then afterwards using reconstruction filter.

4. Fractal Image Compression

Fractal compression is a technique of lossy compression. It try to construct an approximation of the original image i.e. correct sufficient to be an acceptable. Its main task to examine similarities between larger and smaller portions of image. It depends not only on the self-similarity but also manage the quality of reliable images. From using this, fractal algorithms convert parts of the images into mathematical data called "fractal codes" which are used to recreate the encoded image. One time an image has been converted into fractal code its relationship to a specific resolution has been lost; it becomes resolution independent. It provide better performance in that it produces an approximation that is closer to the original at higher compression ratios.

4.1 Why Fractal Image Compression

4.1.1 For self-similarity in the images

A typical image does not consist self-similarity but it consist different kind of similarity. Using this fractal compression achieve compression .To do this, firstly take starting image and then divide it into non-overlapping sub-blocks(parent blocks). Further each parent blocks divided into 4 blocks(child blocks).Compare one-by-one each child block from the parent block and determine which larger block has the smallest difference according to some computation between larger block and smaller block. This is done for each block. During decompression, opposite processing is done to recover the original image. The quality of fractal image compression is rely on block size. Smaller the Block size, more accurate will be the encoding of the image and better quality of the decompression image.

4.1.2 Resolution Independence

It is very important feature of fractal image compression. It occurs after the image being converted into fractal code i.e. its relation is free from the specific resolution.

4.1.3 Fractal interpolation

The resolution independence can be used to increase the display resolution of an image .This process is also called fractal interpolation. In this, through fractal compression, image is encoded into fractal codes and afterwards decompressed at higher resolution.

4.2 Advantages and Disadvantages of Fractal Image Compression

4.2.1 Advantages

- Fast decompression.
- High Compression ratio.
- Ability to produce a good quality decoded image.
- Preserve a high degree of self-similarity.
- Resolution-free decoding.

4.2.2 Disadvantages

- Long encoding time.

5. Pollination Based Optimization Algorithm

5.1 Optimization

Optimization is a process through which we can produce the optimum results to the problems. It is an auto-mated design technique. According to this technique, it is important to differentiate between design and analysis. Analysis is the process in which determines the response of specific system to the particular combination of input parameter. On the other hand, design is a process in which we define a system.

5.2 Techniques of Optimization

There are many optimization techniques through which we can improve efficiency of fractal image compression. Some techniques are given below:

- Pollination Based Optimization
- Ant Colony Optimization
- Particle Swarm Optimization
- Biogeography Based Optimization
- Genetic Algorithm

5.2.1 Pollination Based Optimization

PBO is a optimization technique which is applied for fractal image compression (FIC). It is process associated with transfer of pollen and such transfers linked with pollinators like birds, insects and other animals. Pollination is of two major forms : Biotic and Abiotic.

Biotic Pollination:- Around 90% of flowering plants belong to the biotic pollination group i.e. pollen is transferred by pollinators like animals and insects.

Abiotic Pollination:- Around 10% of flowering plants belong to the abiotic pollination group, in which do not need any pollinators. In this, pollination is done with the help of wind and diffusion.

It is a process of transfer of pollen from male parts (anther) of flower to the female parts (stigma) of flower. Pollination is achieved through Cross-pollination or Self- pollination. Cross-pollination is a pollination occur when pollen are from different plant. Self-pollination is pollination occur when pollen are from same plant. Pollinators do not care about plant benefits. They pollinate to get pollen from flowers to meet their energy requirement and to provide offspring. If the success of pollination goes above normal, plants decrease the resource expenditure for generating nectar, floral display and fragrance in the flowers. If the success of pollination goes below normal, plants increase the resource consumption for producing nectar, more floral display and fragrance in the flowers. With the help of this algorithm ,

effort is made to reduce the search complexity of matching between range block and domain block. To improve the satisfactory quality of decoded image, PBO algorithm is proposed.

5.2.2 Ant Colony Optimization

Ant colony optimization is based on the pheromone deposition of ants. It generates a new set of solutions with each iteration. It is a meta heuristic that can be used to refine method applicable to a wide set of problems with few modification..

5.2.3 Biogeography Based Optimization

BBO is population based optimization algorithm. It does not affect reproduction or the generation. This clearly distinguishes it from reproductive strategies such as evolutionary strategies.

5.2.4 Genetic algorithm

The genetic algorithm is based on the natural selection in biological evolution. In this, individuals are coded as an integers. The selection is managed through selecting parents proportional to their fitness. So individuals must be assessed before the first selection is done.

5.2.5 Evolutionary Strategy

The evolutionary strategy is based on the multiple parents assign to offspring. The most fit offspring come the next generation of parents. In this, individuals are coded as real numbers. Upon recreation, parents are selected at random and the fittest off springs are chosen and inserted in the next generation. ES individuals are self-adjusting.

6. Conclusion

The field of fractal compression is relatively new, as is the study of fractals, and as such there is no standardized approach to this technique. The main idea in this compression scheme is to use Iterated Function Systems **(IFS)** to reproduce images. An important property of fractals is that they exhibit self-similarity. By partitioning an image into blocks, typically 8x8 or 16x16 pixels, it becomes possible to map small portions of an image to larger portions. In addition, the smaller portions are reproduced by use of affine transformations. These transformations effectively map squares to parallelograms through translation, scaling, skewing, rotation, etc. In this process an image can be stored as a collection of affine transformations that can be utilized to reproduce a nearby copy of the original image. The process is iterative in that detail is added after each pass through the function set. The process is computationally intensive but can yield much improved compression ratios. Fractal compression area is great. It should be possible to take advantage of the large compression ratios achieved from fractal compression and produce a trade-off of compression ratios for information loss to achieve a lossless result. This could be achieved through a post comparison of a fractally compressed file and its original data. By then using a traditional compression scheme, encoding of the differences could be implemented in such a way that a lossless representation of the original data can be reproduced. Another approach is to let the user select sections of the image to be compressed as lossless.

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