Compressed Video Data Transmission over Wireless Network

[1]Warsha Shrirame, [2]Dr. G. M. Asutkar

[1] *M. tech (Student), Department of Electronics and Communication, Priyadarshini Institute of Engineering and Technology Nagpur, Maharashtra, India*

[2] *Principal, Department of Electronics and communication, Priyadarshini Indira Gandhi College of Engineering Nagpur, Maharashtra, India*

---***---

Abstract- *As the storage and transmission of uncompressed video would be extremely costly and impractical, the compression of video has become a necessity and very important because it helps to reduce the memory capacity and have faster transmission rate. In this paper Fractal Image Compression method is used to compress an Audio/Video Interleaved file (AVI Video file) because of its high compression ratio with good quality and resolution independent characteristics. Fractal Image compression is based on the self-similarities within the different portions of the same image. In the transmission part the MIMO-OFDM system is used for the transmission of the compressed AVI video file. At the decoding stage the inverse fractal image compression executed to obtain the decompressed images of the video file and reconstruct the AVI video file. The proposed algorithm will be tested and performance parameters (compression ratio, average PSNR, size before and after the compression) will be registered.*

Key Words: Video compression, Fractal Image Compression, IFS

1. INTRODUCTION

One of the most important problems in computer applications such as Internet communication, digital libraries, board casting, teleconferencing, mobile telephone, surveillance, and entertainment is the storage and communication of the digital video. People now expect to be able to access the digital videos through the wide range of different devices and over various networks. Compression is the process of reducing the number of bits required to represent the image and video for storage and transmission while retaining the quality of original image. The main idea of video compression is to exploit redundancies that are present in the video (spatial and temporal redundancy).In general, in video compression the video sequences contain significant amount of statistical and subjective redundancy within and between frames. The main purpose of compression is the bit rate reduction for storage and transmission by exploring both spatial and temporal redundancy and by using entropy encoding techniques encode a "minimum set" of information this results in a compression of coded video data compared to original source data .The exploited spatial and temporal redundancies are called spatial and temporal redundancy. Previously developed compression standards are H.263 and MPEG-4, both standards use wavelet transform techniques. Recently developed compression is the Fractal image compression which has the potential for high compression rate, high decompression speed, high bit rate and resolution independence[1][2][6].

1.1 FRACTAL IMAGE COMPRESSION

Fractal image compression is based on the self similarity property of an image, where some part of image called range block(R block) is similar to the large part of image called domain block (D block). It is lossy type of compression (Some information present in image or video is discarded so that the original raw representation of image or video can only be approximately reconstructed from the compressed representation with high compression ratio, decompressed image is not same as original image The idea of fractals is not new, it goes back to the beginning of the last century. In 1977 Benoit Mandelbrot published his book *The Fractal Geometry of Nature*, in this book, he tried to show the existence of fractals in nature like clouds, mountains and trees also paid attention to the importance of fractals and its geometry.[2] However, he did not think of fractals as a method for compression. Michael Barnsley was the first person to use the idea of fractals in image compression. In 1988 he applied a fractal image compression method based on IFS (Iterated Function system).Iterated Function System is collection of contractive affine transformations that is each set of contractive affine transformations, defines a unique image or what is called fractal and instead of generating an image from a given formula, the aim in fractal image compression is to find a set of transformations that can represent a given image.[3] He claimed that fractal coding may reach compression ratios up to 1000:1 which sounds like a very impressive rate of compression but the approach requires manual intervention[6].Subsequently, Jacquin proposed a new fractal image compression which is the improved IFS that is proposing the partitioned iterated function system (PIFS), where the image is partitioned into number of ranges that are non-overlapping, and range-wise IFS are found and this can be automatically done. In fractal compression which is able to automatically determine the fractal code without manual intervention and it is based on image block [3] [6]. Therefore, Jacquin's method has become a typical representation for this research direction; fractal image compression has become practical since then. Currently, fractal image compression has got extensive attention by the research community because of its novel ideas, high compression ratio and resolution independent characteristics, and it is recognized as one of the most the promising next generation image compression technology besides, fractal compression also can be applied to audio and video compression[2].

1.2 Basic Encoding procedure

The encoding procedure of fractal image compression is very simple but it requires a lot of computing, and this result in a long encoding time.
Following are the steps for encoding in fractal image compression: [1] [4] [6]
Input: An original image
Output: Fractal codes after the compression of original image

1. Read an image.
2. Divide or partition the image into non overlapped blocks of ranges (Range block, R for short) of square sizes covering complete image and non-overlapped blocks of domains (Domain block, D for short). Basically the size of domain block will be twice the range block.
3. Rescale the domain blocks to the same size of range blocks and find the eight possible transformations for each block (Eight Affine transformations proposed by Jacquin).
   After transformation, we can get eight image blocks for each D' block and all new D' blocks composite the new D pool.
4. Compare each R block with all D blocks in D pool to find best match. The similarity can be measured with average variance MSE. The MSE can be represented as
   $MSE=|| (s_k * D_k + o_k * I - R_k) ||$
5. Save the following coefficients:

- The location of the domain block (*e and f*)
- Best transformation on domain block (*M*)
- Contrast (scaling factor s)
- Offset (o)

6. Continue doing the same for the rest of the range blocks until the last one is reached.

1.3 Basic Decoding procedure

The decoding procedure of fractal image compression is much faster as compared to encoding
Following are the steps for decoding in fractal image compression:
Input: Fractal image compression code
Output: Decompressed image file

1. Choose any arbitrary image (usually just a gray background) which is identical to the size of original image as the reference image.
2. Apply the transformation and translation described in the fractal code on an arbitrary image iteratively.
3. Take the output of the first iteration to the input of the next iteration and continue doing the same until an image will produce which looks approximately like the original image.

The time taken for the decoding is depends on the number of the iteration. The number of iterations varies from 4 to 12+.

2. Fractal Image compression on AVI video file

The system consists of two stages: encoding and decoding. In the encoding stage the first step is to open or read the given AVI file and get the sequence of frames/images, after this read the image (RGB components) and convert it into YC_bC_r color space. Y is the luminance component of the monochrome image containing the structural information of the image and the two chrominance (C_b and C_r) components containing the hue and saturation information of the frame. Then each frame will be compressed using the fractal image compression (FIC) separately and after compression save the fractal codes for each frame (for components YC_bC_r) into the file. In the decoding stage the reverse steps are performed. The fractal codes for each frame (with its three components) are loaded from a compressed AVI file and decoded using the fractal inverse coding and then converted to RGB color space. Then the resulting images are combined together in an AVI video file. [1][7]

The encoding steps for the AVI video files are:
Input: AVI video file
Output: Compressed video file

1. Read the input AVI video file.
2. Split the AVI file into series of frames/images (Bit map images).
3. Read the color image (frame) and convert it to YC_bC_r color space.
4. Apply FIC on each frame (components Y, C_b, C_r).
5. Save the Fractal codes for each frame into the compressed file.
6. End compression.

The decoding steps for the AVI video files are:
Input: Compressed AVI video file
Output: Decompressed AVI video file

1. Read the saved fractal code for each frame components (Y, C_b, C_r) from the compressed AVI video file in sequence.
2. Perform the decompression procedure to each component and retransform them from YC_bC_r to RGB color space images (bitmap images).
3. Finally combine the series of bitmap images into AVI video file.
4. End decompression.

Fig 1 shows the general block diagram for the complete procedure for encoding and decoding of an AVI video file.

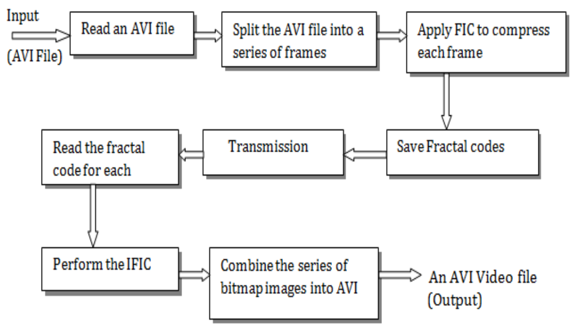

Fig-1 The block diagram of compression and decompression of the AVI video file

2. Experimental Results

The compression algorithm is conducted on the AVI video file. The results presented were obtained using the MATLAB Software Simulator. We take an Akiyo.avi video file. The video runs at (29) frames/second. The algorithm was tested and performance parameters (average PSNR, Compression ratio, size before and after compression) were registered. The algorithm used to compress the Akiyo.avi video file, Table 1 shows the input parameters of the Akiyo video file we selected only 50 frames out of 300 frames considering the video file cvid1.avi having the 50 frames with 15 frames/second Table 2 shows the input parameters for the cvid1.avi file and after applying the FIC method successfully on that the compression ratio we get is 0.5712.

Table -1: Input parameters of an akiyo.avi video file

Parameter	Value
Video file	Akiyo.avi
Size	983 KB
Number of frames	300
Length	10s
Frame Width	352
Frame Height	288
Data Rate	662kbps
Total Bit Rate	662kbps
Frame Rate	29frames/second

Table -2: Input parameters of cvid1.avi video file

Parameter	Value
Video file	cvid1.avi
Size	803KB
Number of frames	50
Length	3s
Frame Width	128
Frame Height	128
Frame Rate	15frames/second

2.1 Performance Metrics of the experiment

- Compression Ratio

The compression performance is computed by the following equation: [1] [2]

Compression Rate = (The file size after compression) / (The file size before compression)

Compression Ratio =100(1- compression Rate)

- PSNR (Peak Signal to Noise Ratio)

PSNR (Peak Signal to Noise Ratio) is used to compute the quality of the reconstructed image compared with the original image by measuring the differences between the two images; the formula used to compute the PSNR is,
$PSNR = 20 \log_{10} (b\ /\ rms)$
Where b is the highest pixel value (255) and rms is the root mean square differences between the two images. PSNR is measured in dB, the highest the PSNR, the better the quality of the reconstructed image. [1][2]
The performance parameters of the channel i.e. transmission rate of the channel and the average PSNR is showing in the fig2. From figure we can say that the average PSNR is constantly increasing as per the symbols of the OFDM. The final average PSNR per frame is showing in the fig2.The size of the video file after compression is 18.5KB.

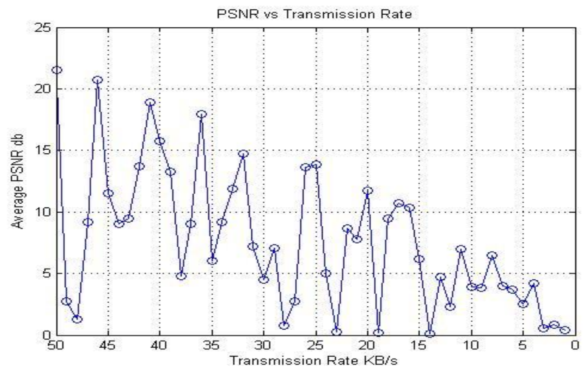

Fig -2: The Avg. PSNR vs. Transmission rate of the channel.

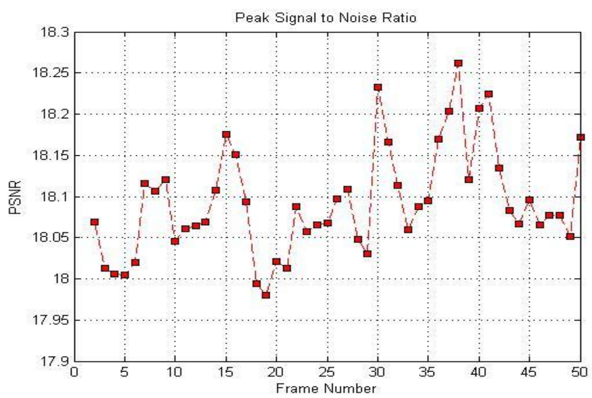

Fig -3: Frame number vs. PSNR of the video file.

3. CONCLUSIONS

This project briefly introduces the basic theory of image/video fractal compression and discusses some typical fractal compression approaches, based on fractal image compression algorithm. Fractal image compression always suffers from the long encoding time. A lot of work has been done on the fractal image compression but in this paper we apply it on the AVI video file. From the results we can say that for the video file also with high PSNR also it is an effective way to compress AVI video as compared to other traditional methods.

ACKNOWLEDGEMENT

It is an immense pleasure in expressing genuine and profound gratitude towards the guide Prof. Dr. G.M. Asutkar for his valuable suggestions, guidance, constant support, and encouragement.
The backbone of my success and confidence lies solely on the blessing of my parents and my family. I would like to specially thank my husband Mr. Manish Narnaware, for his constant support and encouragement.

REFERENCES

[1] Nevart A. Minas, Faten H. Mohammed Sediq, "Compression of an AVI Video File Using Fractal System", *IJCSI International Journal of Computer Science Issues, Vol. 10, Issue 5, No 2, September 2013.*

[2] Y. Fisher, "Fractal Image compression: Theory and Application", *Springer-Verlag, New York, Inc., 1995.*

[3] Y. Brijmohan and S. H. Mnene, "Video Compression for Very Low Bit -Rate Communications Using Fractal and Wavelet Techniques", *e-book browse, No 19, 2010.*

[4] Mohamcd Elsherif, Mohsen rashwan, Alaa Elsayad "Matching Criteria in Fractal Image Compression" *Proc. 43rd IEEE Midwest Symp. On Circuits and Systems, Lansing MI, Aug 8-1 I, 2000.*

[5] A. Jacquin, "Image coding based on a fractal theory of iterated contractive image transformation" *IEEE Trans. Image Processing vol. 1, no. 1, pp.18-30, Jan. 1992.*

[6] Hai Wang, "Fast Image Fractal Compression with Graph-Based Image Segmentation Algorithm", *International Journal of Graphics Vol. 1, No.1, November, 2010.*

[7] M. S. Lazar, L. T. Bruton, "Fractal Block Coding of Digital Video", *IEEE Trans. Circuits and Systems for Video Technology, vol.4, no.3, pp. 297-308, June 1994*

BIOGRAPHIES

Warsha S. Shrirame, M. Tech (Electronics Engineering (Communication)) a student of Priyadarshini Institute of Engineering. And Technology Nagpur. Research interests are image and video compression, signal processing.

Dr. G. M. Asutkar, Principal Priyadarshini Indira Gandhi College of Engineering Nagpur, Research Interests is Image/video compression, wireless sensor Network. Computer communication.

