Vandana Publications
IJEMR

Volume-4, Issue-5, October-2014, ISSN No.: 2250-0758
International Journal of Engineering and Management Research
Available at: www.ijemr.net
Page Number: 111-114

Space Frequency Segmentation for Image Compression

Monika Bist[1], Astha Sharma[2]
[1]Pursuing M.Tech., GRD Institute of Management & Technology, Dehradun, Uttarakhand, INDIA
[2]GRD Institute of Management & Technology, Dehradun, Uttarakhand, INDIA

ABSTRACT

Everyday enormous amount of information is stored, processed, and transmitted digitally. The need for high-performance image compression is becoming greater and greater as digital imagery finds its way into many areas of everyday life. In this paper we publish a new method of Image Compression from space frequency segmentation

Keywords— Decoder, Encoder, Entropy, Quantiser, Wavelet Transform.

I. INTRODUCTION

While 20 years ago digital images were seldom used, today they are used in many diverse applications, including multimedia technology, digital photography, Internet viewing, image archiving, and medical imaging. In order to transmit and store digital images, the images must be compressed; otherwise, each image would require a huge amount of memory. Because digital images are used so extensively, image compression technology has surged forward in recent years. Much work has been put into developing an image compression standard that will have a broad range of functionality, as well as an excellent compression rate.

II. METHODOLOGY

Space Frequency Segmentation

Space-frequency segmentation (SFS) finds the optimum basis to represent an image from a large family of possible bases. As the name suggests, space-frequency segmentation involves the decomposition of an image using a hierarchy of space and frequency partitions. Space partition refers to the division of an image into four spatial quadrants, and frequency partition refers to the division of an image into four frequency sub-bands. The sub-images produced by space or frequency partitioning can also be successively partitioned in space or frequency, so that a decomposition tree of space and frequency partitions is built, up to some maximum depth. The algorithm is symmetric in terms of space and frequency partitions – decomposition in either space or frequency is allowed at each branch of the decomposition hierarchy.

III. PRIOR APPROACH

SPIHT

Set Partitioning in Hierarchical Trees (SPIHT) is an image compression algorithm that exploits the inherent similarities across the sub-bands in a wavelet decomposition of an image

JPEG 2000

JPEG 2000 is a wavelet-based image compression standard. It was created by the Joint Photographic Experts Group committee in the year 2000 with the intention of superseding their original discrete cosine transform-based JPEG standard (created 1992).

Lossy Compression Model

A lossy compression method is one where compressing data and then decompressing it retrieves data that may well be different from the original, but is close enough to be useful in someway. Lossy compression is most commonly used to compress multimedia data (audio, video, still images), especially in applications such as internet telephony. In some cases lossy image compression can produce a much smaller compressed file than any known lossless method, while still meeting the requirement of application. The purpose of lossy image compression is to minimize the no. of bits needed to represent an image without introducing any important degradation.

Lossless Compression Model

It is a class of data compression algorithms that allows the exact original data to be reconstructed from the compressed data. It is used when it is important that the original and decompressed data be identical, or when no assumption can be made or whether certain deviation is uncritical .Typical examples are executable programs and sources codes. Some image file formats like PNG or GIF use only lossless compression.

Most lossless compression programs use two different kinds of algorithms: one which generates a statistical model for input data and other which maps the input data to bit sequence using this model in such a way that "***probable***" data will produces shorter output than "***improbable***" data. Primarily encoding algorithms used to produce bit sequence are HUFFMAN CODING and ARITHEMATIC CODING. Its limitation is that lossless data compression cannot guarantee compression for all input data sets.

Near Lossless Compression Model

In this compression algorithm is allowed to introduce some coding error so that that the absolute difference between each reconstructed pixel and its original value is bounded by a fixed quantity that predefined in the coding process .Typical values for the maximum error range from 1 to 5, depending on the image and on the targeted bit rate . Near lossless compression is useful when a lower bit rate is required but the image quality cannot be comprised in an unpredictable manner.

IV. OUR APPROACH

This deals particularly with the compression of grayscale images using a recent compression technique, space-frequency segmentation. This method finds the optimal representation of:-

– An image from a large set of possible space-frequency partitions

– An image from quantizer combinations

– Also if the images to code are statistically inhomogeneous.

The various processes that will be dealt during the project development are Space Frequency segmentation (SFS), Quantization, Entropy Coding etc. A detail of the whole process is discussed with the help of block diagram given below:-

Figure 3.1: Encoding Process

Figure 3.2: Decoding Process

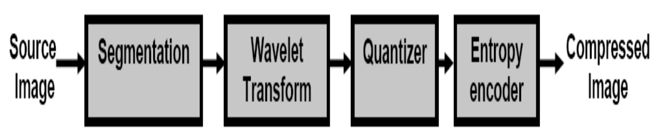


Figure 3.1: Encoding Process

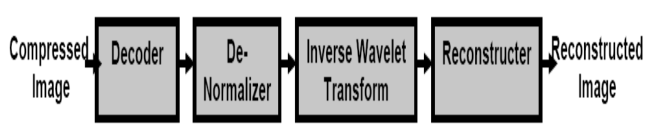
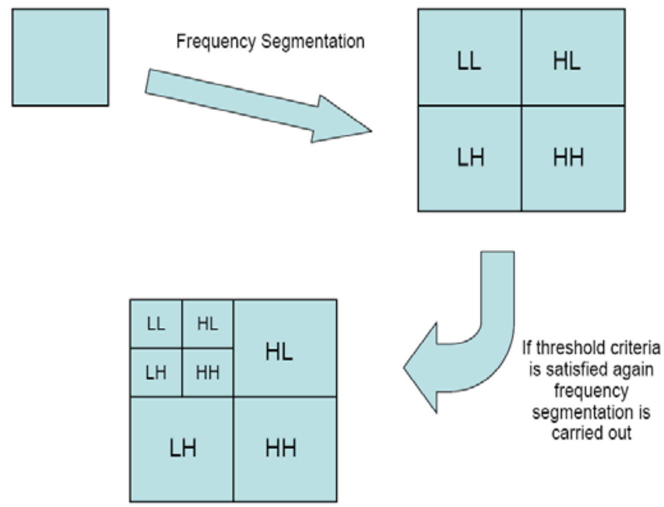


Figure 3.2: Decoding Process



Space-frequency segmentation (SFS) finds the optimum basis to represent an image from a large family of possible bases. As the name suggests, space-frequency segmentation involves the decomposition of an image using a hierarchy of space and frequency partitions. Space partition refers to the division of an image into four spatial quadrants, and frequency partition refers to the division of an image into four frequency sub-bands. The sub-images produced by space or frequency partitioning can also be successively partitioned in space or frequency, so that a decomposition tree of space and frequency partitions is built, up to some maximum depth

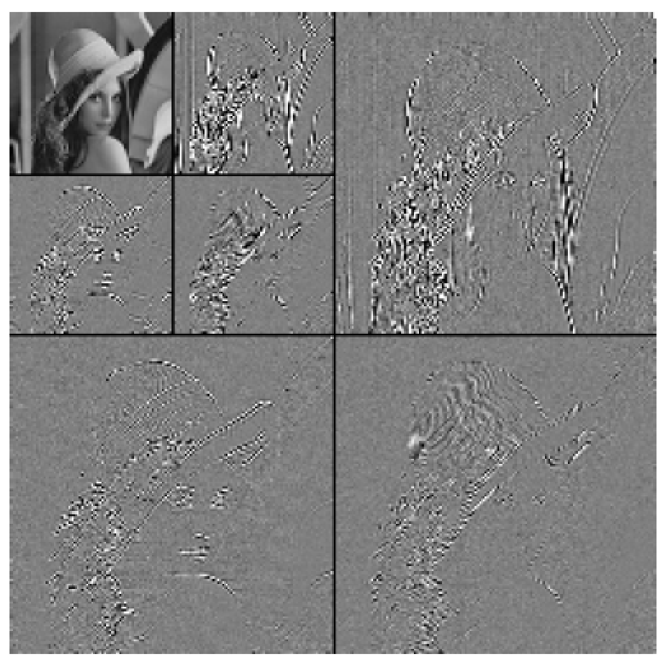


Figure 2.1**:** Wavelet Transform of image

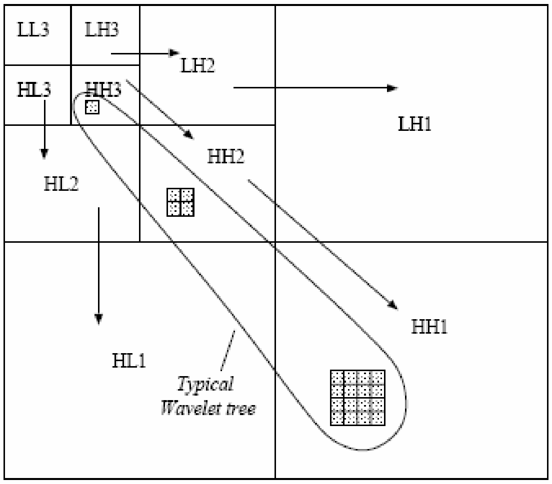


Figure 2.2: Space-Frequency structure of Wavelet Transform

The concept of *wavelet packets* extends the standard wavelet transform to include all possible binary frequency decompositions. To apply this partition gamut to image coding, a set of quantisers must be defined and a search done to identify the best partition-quantiser combination in the rate-distortion sense.

Entropy Coding

The final step of the encoding process is to code the quantized coefficients arithmetically on a bit-plane basis. The encoding technique used in this case is Huffman Coding

Original Source		Source Reduction	
Symbol	Probability	1	2
a_2	0.5	0.5	0.5
a_4	0.1875	0.3125	0.5
a_1	0.1875	0.1875	
a_3	0.125		

Table 3.1: Source Reduction

Original Source			Source Reduction			
Symbol	Probability	Code	1		2	
a_2	0.5	1	0.5	1	0.5	1
a_4	0.1875	00	0.3125	01	0.5	0
a_1	0.1875	011	0.1875	00		
a_3	0.125	010				

Table 3.2: Code Assignment Procedure

Encoding Process

The encoding process takes the input image and finally converts it into a compressed structure. The detailed process is stated as under:

- Initially the test image (i.e. the image to be compressed) is taken.
- Then the spatial segmentation of the original image is carried out i.e. the image is divided into the four quadrants.
- The next process is the wavelet decomposition of each quadrant (also termed as frequency segmentation) to a single level, the approximation and detailed part of each image quadrant is calculated.
- On the basis of the approximation energy, the further decision for the image quadrants is made.
- If the approximation energy is low, then we can carry out wavelet decomposition to a greater level i.e. that part of the image can be compressed to a greater extent.
- Else if, the approximation energy is high then we have to further segment it in the spatial domain.
- After completing this process, quantization process is applied to each of the final segment.
- Each of the quantized value is further compressed by carrying out huffman encoding.
- Finally we obtain a structure in which contains the coded values, which represents the compressed image.

Decoding Process

The encoded structure is provided to the decoder which finally converts it into the resultant image. These details are as follows:

- The image obtained after the compression process is taken (i.e. the compressed image structure).
- The encoded information is decoded using Huffman decoding to obtain the various coefficients.
- The de-normalization process is carried out on the decoded information.
- Now we carry out the inverse wavelet transform so as to get the various segments.
- These segments are further passed as the input to the re-constructor.

The re-constructor combines all the segments to obtain the final image

V. CONCLUSION

Although the comparative quantitative study shows that many other techniques (i.e. JPEG2000, SPHIT) is better than this technique, yet the qualitative study (i.e. subjective analysis of the figure) shows that the quality of the reconstructed figure is better than other techniques.
Since in the case of Space-Frequency Segmentation, the representation is adapted to suit the image, SFS can be a good choice for images with unusual features, such as speckle texture and the unique shape of the scanned region in the ultrasound images. SFS can do a better job of preserving both fine detail and low contrast detail. Hence

the technique can be of great use in the areas where the quality of the image carries significance.

Although computational complexity can be varied by varying the algorithm parameters, the high computational cost remains the primary drawback in Space-Frequency Segmentation

REFERENCES

[1] R. F. Wagner, M. F. Insana, and D. G. Brown, "Unified Approach to the Detection and Classification of Speckle Texture in Diagnostic Ultrasound," Optical Engineering, vol. 25, pp. 738-742, 1986.

[2] M. F. Insana, R. F. Wagner, B. S. Garra, and T. H. Shawker, "Analysis of Ultrasound Image Texture via Generalized Rician Statistics," Optical Engineering, vol. 25, pp. 743-748, 1986.

[3] P. M. Shankar, "Speckle Reduction in Ultrasound B-Scans Using Weighted Averaging in Spatial Companding," IEEE Trans. on Ultrasonics, Ferroelectrics, and Freq. Control, vol. 33, pp. 754-758, 1986.

[4] X. Zeng, E. A. Geiser, A. F. Laine, and D. C. Wilson, "Homomorphic Wavelet Shrinkage and Feature Emphasis for Speckle Reduction and Enhancement of Echocardiographic Images,"Proceedings of SPIE, vol. 2710, pp. 658-667, 1996.

[5] J. Shapiro, "Embedded Image Coding Using Zerotrees of Wavelet Coefficients," IEEE Transactions on Signal Processing, vol. 41, pp. 3445--3462, 1993.