New Perspectives and Improvements on the Entropy Encoding in Wavelet Image Compression

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Abstract

The Images require substantial storage and transmission resources, thus image compression is advantageous to reduce these requirements. The report covers some background of wavelet analysis, data compression and how wavelets have been and can be used for image compression. It was discovered that thresholding was had an extremely important influence of compression results so suggested thresholding strategies are given along with further lines of research that could be undertaken. demand for high speed and efficient wireless communication systems for image transmission has grown due to increasing demands of wireless multimedia applications such as remote sensing satellite, nuclear medicine, telemedicine, teleconferencing, broadcast television and accessing Internet services on mobile phones with a high-bit-rate transmission and better quality of the offered services. This paper discusses the innovative techniques for image compression and application in above mentioned communication systems.

Keywords: *Wireless Communication, Digital Signal Processing, Digital Image Processing, Wavelet Transform*

1. INTRODUCTION

Reducing the amount of data required to represent a digital image, reduce the memory required for storage, improve the data access rate from storage device and reduces the bandwidth and time required for data transfer across communication channel that problems are deal by compression [1]. Two ways of classifying compression techniques are mentioned here. In lossless compression schemes, the reconstructed image, after compression, is numerically identical to the original image. However lossless compression can only a achieve a modest amount of compression. An image Reconstructed following lossy compression contains degradation relative to the original. Often this is because the compression scheme completely discards redundant information. However, lossy schemes are capable of achieving much higher compression. Under normal viewing conditions, no visible loss is perceived (visually lossless).In predictive coding, information already sent or available is used to predict future values, and the difference is coded[2]. Since this is done in the image or spatial domain, it is relatively simple to implement and is readily adapted to local image characteristics. Differential Pulse Code Modulation (DPCM) is one particular example of predictive coding. Transform coding, on the other hand, first transforms the image from its spatial domain representation to a different type of representation using some well-known transform and then codes the transformed values (coefficients)[3]. This method provides greater data compression compared to predictive methods, although at the expense of greater computation.

1.1Principle Behind Compression

A common characteristic of most images is that the neigh boring pixels are correlated and therefore contain redundant information. The foremost task then is to find less correlated representation of the image. Two fundamental components of compression are redundancy and irrelevancy reduction [4,5].

Redundancy reduction aims at removing duplication from the signal source (image/video).

Irrelevancy reduction omits parts of the signal that will not be noticed by the signal receiver, namely the Human Visual System (HVS).

In general, three types of redundancy can be identified:

Spatial Redundancy or correlation between neighbouring pixel values. Spectral Redundancy or correlation between different color planes or spectral bands. Temporal Redundancy or correlation between adjacent frames in a sequence of images (in video applications)[6].Image compression research aims at reducing the number of bits needed to represent an image by removing the spatial and spectral redundancies as much as possible. Since focus only on still image compression and not worry about temporal redundancy [7].

2. LITERATURE SURVEY

Image Compression with Different Types of Wavelets different wavelets have been used to perform the transform of a test image and their results have been discussed and analyzed. The analysis has been carried out in terms of (peak signal to noise ratio) obtained and time taken for decomposition and reconstruction. This analysis will help in choosing the wavelet for decomposition of images as per their application. The jpeg 2000 Still Image Compression Standard. In this article the jpeg 2000 standard is presented and performance comparisons with established standards are reported [8]. This article is intended to serve as a tutorial for the jpeg 2000 standard, the main application areas and their requirements are given. The architecture of the standard, with the description of the tiling, multicomponent transformations, wavelet transforms, quantization and entropy coding are also describe. Some of the most significant features of the standard are presented in this article, such as region-of-interest coding, scalability, visual weighting, and error resilience and file format aspects. Some comparative results are reported and the future parts of the standard are discussed [9]. Selection of Mother Wavelet for Image Compression on Basis of Nature of Image by This paper compares compression performance of wavelets along with results for different frequency images. Based on the result, it is proposed that proper selection of mother wavelet on the basis of nature of images, improve the quality as well as compression ratio remarkably. The prime objective is to select the proper mother wavelet during the transform phase to compress the color image [10]. This paper includes the discussion on principles of image compression, image compression methodology, the basics of wavelet and orthogonal wavelet transforms, the selection of discrete wavelet transform with results and conclusion.

Fourier analysis and Wavelet Analysis In this article compare the classical methods of Fourier analysis with the newer methods of wavelet analysis. Given a signal, say a sound or an image, Fourier analysis easily calculates the frequencies and the amplitudes of those frequencies which make up the signal. This provides a broad overview of the characteristics of the signal, which is important for theoretical considerations. However, although Fourier inversion is possible under certain circumstances, wavelet analysis is very effective because it provides a simple approach for dealing with local aspects of a signal [11]. Wavelet analysis also provides us with new methods for removing noise from signals that complement the classical methods of Fourier analysis. These two methodologies are major elements in a powerful set of tools for theoretical and applied analysis. Explore various schemes of entropy encoding and how they work mathematically where it applies. Entropy encoding is a way of lossless compression that is done on an image after the quantization stage [12]. It enables to represent an image in a more efficient way with smallest memory for storage or transmission.

2.1WAVELET TRANSFORM

The Wavelet Transform provides a time-frequency representation of the signal. It was developed to overcome the short coming of the Short Time Fourier Transform, which can also be used to analyze non-stationary signals. While gives a constant resolution at all frequencies, the Wavelet Transform uses multi-resolution technique by which different frequencies are analyzed with different resolutions. Wavelet transform represents a windowing technique with variable-sized regions [13]. Wavelet transform allows the use of long time intervals where we want more precise low-frequency information, and shorter regions where we wanthigh frequency information

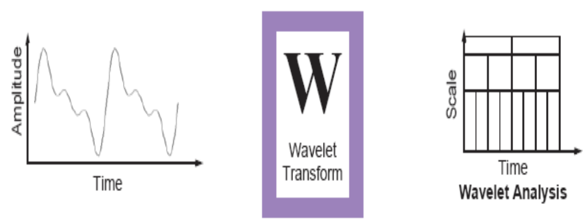

Figure 2.1. Wavelet Transform analysis

Fourier analysis consists of breaking up a signal into sine waves of various frequencies. Similarly, wavelet analysis is the breaking up of a signal into shifted and scaled versions of the original (or mother) wavelet. A wavelet is a waveform of effectively limited duration that has an average value of zero. Figure2.2 shows the sine wave and wavelet function.

3. EXPERIMENT

Performance of the digital image compression are measured by following parameter

Compression efficiency: It is measure by compression ratio. Compression ratio is defining as the ratio of the size of the original image data over the size of the compressed image data [14].

Distortion measurement: It is used to measure what percent of information has been lost when a compressed image is produced. It is measure by PSNR and Energy of the image [15].

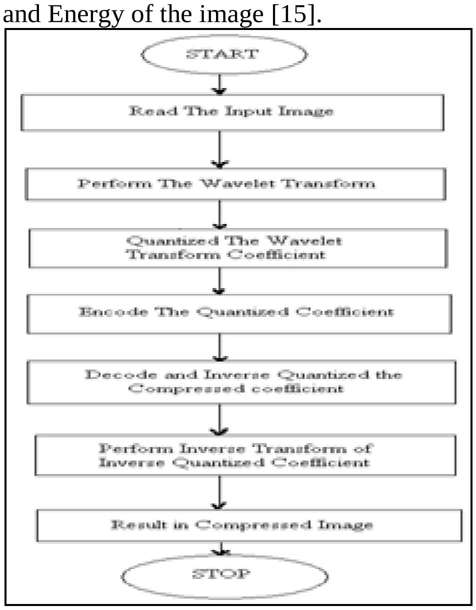

Figure.3 Flow chart for image compression

3.1algorithm For Image Compression

Step1: load image I= imread(filename)

Step2: find wavelet function twiddle factor W_N.

Step3: find the wavelet transform by $C = W_N . X . W_M{}^T$

Step4: find quantization of the wavelet coefficient.

Steo5: perform Huffman coding

Step6: find PSNR, Entropy and energy of the image.

3.2wavelet Transform Using Haarfunction And Corresponding Image With Compression Ratio.

A=imread (tarun.jpg)

W_N = haar (N); W_M = haar (N);

[C, B]=Wtransform (A, $W_{N,}$ W_M);

Figure1, imshow (A);

Figure2, subplot (1, 2, 1), imshow (C);

Subplot (1, 2, 1), imshow (B);

3.2 Wavelet Transform and Corresponding Image.

The transform is based on three wavelet function.

(1)Haar.

(2)Duabechies 4 (dB4).

(3)Duabenchies 6 (dB6)

4. IMPLEMENTATION AND RESULT

Qualities of the transform image are measured by Energy and Compression ratio.

Wavelet Function / Image (Total Energy)	HAAR	db4	Db6	DCT
	Energy %	Energy %	Energy %	Energy %
1. FAA_radar.jpg (7.0099×10^4) (25:1)	98.35	98.74	98.44	97.8 4
2. SCR_radar.jpg (1.1989×10^4) (25:1)	98.78	99.18	98.89	97.6 2
3. Space radar.jpg (1.4450×10^4) (20:1)	98.77	99.24	98.90	97.4 8

4.1 Quality Measurement

The compression method was applied to different images like tarun.jpg, barb.gif, city.bmp, FAA_radar.jpg, Space radar.jpg and SCR_radar.jpg and corresponding result for each case are discussed. The basic procedure followed is after the reading image, wavelet transform is applied to get wavelet coefficient, which are quantized. The quantized coefficients are encoded. Then the decoding is done and inverse quantization is carried out on the compressed coefficient and in the next step inverse wavelet transform is done to get the compressed image.

IMAGE NAME	ENTROPY
1. sarf.gif	0.998
2. City.bmp	0.0998
3. tarun.jpg	0.0998
4. Cameraman.tif	0.623

Table4. Entropy of the different image

5. CONCLUSION AND FUTURE SCOPE

While the DCT-based image coders perform very well at moderate bit rates, at higher compression ratios, image quality degrades because of the artifacts resulting from the block-based DCT scheme. Wavelet-based coding on the other hand provides substantial improvement in picture quality at low bit rates because of overlapping basis functions and better energy compaction property of wavelet transforms. an Image Compression technique based on JPEG 2000 using Wavelet transform methods. Wavelet transform method used the wavelet function for transformation and transform image are quantized for more compression. A number of wavelet functions are used for wavelet transform in image compression methods such are Haar wavelet, Daubenchies4 and Daubenchies6 etc. After the compression the performance parameters such as the PSNR, Energy and Compression ratio for different wavelet function are obtained and tabulated. Based on the results obtained the conclusion is that, daubenchies4 is the good wavelet function as compare to haar and duabenchies6. Daubenchies4 gave the good quality of image and PSNR value for different compression ratio.

Some salient features of image compression can be summarized as:

- Reduction of memory requirement for storage.
- Reduction of Bandwidth and time requirement for data transfer in communication channel.
- Improve the data access rate.

Future Scope

The JPEG-2000 standard will incorporate many of these research works and will address many important aspects in image coding in future.

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