Image Compression using Stw and Wdr Wavelets

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Abstract

This paper presents the wavelet techniques used for compression and uncompression of gray scale and true color images. The valid compression methods are STW (Spatial Orientation Tree Wavelet), WDR(Wavelet Difference Reduction) used in this paper, We are using bior 4.4 wavelet for image compression.In this paper Comparison of different quality assessment metrics for the enhancement and compression techniques are carried out. This comparison is done on the basis of subjective and objective parameters. Subjective parameter is visual quality and objective parameters are Peak signal-to- noise ratio (PSNR), Compression Ratio (CR), Mean square error (MSE), L2-norm ratio, Bits per pixel (BPP) and Maximum error.
Keywords: BPP, CR, L2-Norm Ratio, Maximum Error, MSE, PCSM, PSNR, STW, WDR

I. INTRODUCTION

Digital images are widely used in computer applications. Uncompressed digital images require considerable storage capacity and transmission bandwidth. Efficient image compression solutions are becoming more critical with the recent growth of data intensive, multimedia based web applications. Digital imaging has an enormous impact on scientific and industrial applications. There is always a need for greater emphasis on image storage, transmission and handling. Before storing and transmitting the images, it is required to compress them, because of limited storage capacity and bandwidth [1].

Broadly, compression techniques can be categorized into lossless and lossy compression methods. Lossless algorithms perform compression without any loss of information of the original signal, e.g. for medical records, whereas the lossy compression algorithms provide larger compression ratios but when the original information is reconstructed some information is lost.

In many cases, it is not necessary or even desirable that there be error-free reproduction of the original image . Lossy compression is also acceptable in fast transmission of still images over the Internet. Here we concentrate on lossy compression methods which are STW and WDR. The five stages of compression and uncompression are shown in fig.1 and fig.2.

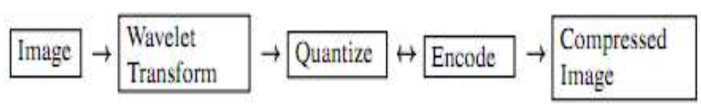

Fig.1 Block diagram for compression of image

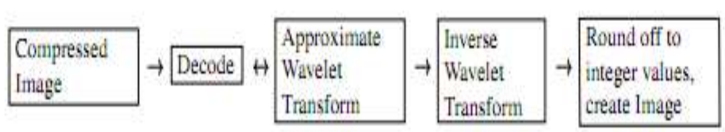

Fig.2 Block Diagram for uncompression of image

II. IMAGE COMPRESSION TECHNIQUES

The following sections discuss compression techniques that are exclusively used 2D images exploiting the unique characteristics.

A. Spatial-Orientation Tree Wavelet:

STW is essentially the SPIHT algorithm; the only difference is that SPIHT is slightly more careful in its organization of coding output. The only difference between STW and EZW is that STW uses a different approach to encoding the zero tree information. STW uses a state transition model. From one threshold to the next, the locations of transform values undergo state transitions. [2]. This model allows STW to reduce the number of bits needed for encoding.

B. Wavelet Difference Reduction:

The WDR algorithm is a very simple procedure. A wavelet transform is first applied to the image, and then the bit-plane based WDR encoding algorithm for the wavelet coefficients is carried out. One of the defects of SPIHT is that it only implicitly locates the position of significant coefficients. This makes it difficult to perform operations which depend on theexact position of significant transform values, such as region selection on compressed data. By region selection, also known as region of interest (ROI), we mean selecting a portion of a compressed image that requires increased resolution. This can occur, for example, with a portion of a low resolution medical image that has been sent at a low bpp rate in order to arrive quickly. Such compressed data operations are possible with the wavelet difference reduction (WDR) algorithm of Tian and Wells [3]–[5]. The term difference reduction refers to the way in which WDR encodes the locations of significant wavelet transform values, Although WDR will not typically produce higher PSNR we will see that WDR can produce perceptually superior images, especially at high compression ratios. The only difference between WDR and the bit-plane encoding is in the significance pass. In WDR, the output from the significance pass consists of the signs of significant values along with sequences of bits which concisely describe the precise locations of significant values [6].

III. EXPERIMENTAL RESULTS AND ANALYSIS

The image Person.jpg is used for the experiments. The original image is shown in Fig. 1. The results of experiments are used to find Peak signal-to- noise ratio (PSNR), Compression Ratio (CR), Mean square error (MSE), L2-norm ratio, Bits per pixel (BPP) and Maximum error.

Fig.3 Original image

Following are the compressed images using EZW and SPIHT wavelet Techniques

Fig.4 Compressed using WDR

Fig.5 Compressed using STW

IV. PERFORMANCE ANALYSES

The performance of the proposed method was evaluated using quality metrics like Compression Ratio (CR), and Peak Signal to Noise Ratio (PSNR) [7], Bits per pixel (BPP), L2-norm.ratio, Maximum error, Mean Square Error. The metrics are obtained from the following equations.

A. The Mean Square Error (MSE)

It represents the mean squared error between the compressed and the original image and is given by:

$$MSE = \frac{1}{mn}\sum_{i=0}^{m=1}\sum_{j=0}^{n=1}\left|X(i,j) - X_c(i,j)\right|^2$$

The lower the value of MSE, the lower the error [8].

B. The Peak Signal to Noise Ratio (PSNR).

It represents a measure of the peak error and is expressed in decibels. It is defined by:

$$PSNR = 10 \cdot \log_{10}\left(\frac{255^2}{MSE}\right)$$

The higher the PSNR, the better the quality of the compressed or reconstructed image. Typical values for lossy compression of an image are between 30 and 50 dB and when the PSNR is greater than 40 dB, then the two images are indistinguishable.

C. Compression Ratio

The compression ratio CR, which means that the compressed image is stored using only CR%of the initial storage size.

D. Bits Per Pixel (BPP):

The Bit-Per-Pixel ratio BPP, which gives the number of bits required to store one pixel of the image.

Table 1:

Sr.no	*Parameters/Methods*	*STW*	*WDR*
1	*MSE*	*43.68*	*21.5*
2	*Max Error*	*67*	*33*
3	*L2 Norm Ratio (%)*	*99.85*	*99.93*
4	*PSNR*	*31.71*	*34.81*
5	*BPP*	*0.83743*	*2.8752*
6	*CR (%)*	*3.49*	*11.98*

V. CONCLUSION

By observing all of the quality parameters of Person.jpg image we can conclude that WDR gives better results than STW.

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