PERFORMANCE ANALYSIS OF BIORTHOGONAL WAVELET AND SPHIT FOR PROGRESSIVE IMAGE TRANSMISSION AND RECONSTRUCTION

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Abstract: If an image to be transmitted over slow connections for application such as telemedicine, then progressive image transmission and reconstruction is an efficient and effective technique for image transmission. Progressive image transmission is a technique that divides transmission of an image to be sent into several phases and the receiver job is to combine the received image data in every phase with previously obtained data to make the image clearer and clearer. In this paper Biorthogonal wavelets is combined with MSPIHT technique for progressive transmission which allows to control the precision and transmission rate, also the modification in SPHIT allows to decide whether further transmission is required or not in 2nd-3rd phase. We have analysed the performance of the technique based on PSNR, MSE, and SSI.

Keywords: Biorthogonal wavelets, MSPHIT.

Introduction:

When an image to be transmitted over an internet, it may require large bandwidth. If the connections are slow then it takes more time for receiving such image. Image compression with progressive image transmission can consistently handle such problem. Image compression significantly reduces the redundancies that are present in image, while progressive image transmission can help to transmit a raster images over low band-width links. During progressive image transmission, an approximate image will be sent first which is sufficient for the user to decide whether further transmission is required or not.

Most of the researchers transform the image from spatial domain into frequency domain to perform PIT. The transformation methods include Fourier transformation, DCT, DWT and so on. DWT is a well established signal transformation technique, where information is organized into different band of frequency. This can be efficiently utilized for progressive transmission. When a wavelet transformation is applied, a correlation exists within and between wavelet transformed frequency sub bands. These correlations are exploited to implement wavelet based compression. These compressed data can be efficiently transmitted using SPHIT algorithm for a distinct receiver.

SPIHT compresses the coefficients of DWT based on their importance in the different phases. The basic idea of SPIHT is based on the concepts of Zerotree [1] and quadtree [7] methods and a receiver will retrieve the significant coefficients in order. Also the SPIHT will refine and re-refine the significant coefficients in every phase. Thus SPIHT has the ability to transmit the data progressively. But if the image is transmitted based on the traditional SPIHT, then the transmitted image can be seen clearly in the later phases. This can be overcome, if we transmit the bit streams of the important coefficients of the subsequently phase on early phase itself than we can see the image more clearly in the earlier phase and can decide whether further transmission is required are not..

Implementation:

Wavelet Toolbox consists of built in functions that provide tool for analysis and synthesis of images & signals using wavelet filters within the MATLAB framework.

In this work, the image to be transmitted progressively is a medical image. The size of the image will be 256 X 256 pixels. To achieve compression 3 level wavelet decomposition is performed using Biorthogonal wavelet 'bio4.4' and progressively transmitted and reconstructed using Modified SPHIT technique.

Wavelet coding is an effective technique for image compression. Wavelets considerably proved as a better algorithm for image compression than any other algorithms. In this compression system we have used biorthogonal wavelet. Instead of orthogonal wavelets like Haar, Daubechies. Biorthogonal filters is a well-known subband filtering technique, that exhibit linear phase property, which is an important property for reconstruction of images. It uses two wavelets, one for decomposition (on the left side) and the other for reconstruction (on the right side) instead of using the single one. In fact biorthogonal wavelet filters are not energy preserving but this thing can't effect its use because it is not a big drawback. SPIHT bifurcates the image coefficients translated by DWT into different lists according to their relative importance for image quality and the transmission policy of SPIHT. Next, the progressive transmission feature of SPHIT allows transmitting the bit streams phase by phase to the receiver, so that it can reconstruct the image progressively from less detailed version to full resolution version. Here the receiver receives the bit streams progressively and combines them with the previous received data after decompresses them. This property allows the receiver to decide whether subsequent transmissions are needed or not without waiting for the whole data to be received.

SPHIT transmits the DWT coefficients based on following method. First it is to specify the total number of bits that are available for encoding procedure which control the quality and rate of transmission. Once it is specified the SPHIT automatically allocates optimal number of bit, such that the compressed image has min distortion. Then based on maximum DWT coefficient SPIHT selects a threshold. This will be the first transmission of SPIHT. Then the coefficients of DWT are compared with the threshold chosen, if the coefficients are greater than the threshold it is consider to be is significant. After this we are with the bit streams having 0 and 1 from the significant coefficients and the refined bit streams of the significant coefficients which are to be transmitted in the first phase. After the receiver acquiring the first transmission, it constructs the image from the received bit streams with SPIHT decompression process. In the second phase instead of transmitting bit stream of second truncation we pass on the bit streams generated from the third truncation first. Then the receiver combines bit streams obtained from first transmission and second transmission and constructs the image with SPIHT decompression process. In the next phase the transmission consist of bit stream generated from the fourth truncation&the bit stream of the second,. The receiver then combines these bit streams with previously received bit streams and reconstructs the image. During subsequently transmissions the entire bit stream obtained from the significant coefficients will be transmitted, meanwhile the receiver progressively add these bits and reconstructs the image In the last phase, we should transmit all the untransmitted bit that are to be transmitted to the receiver. When the receiver gets the entire bit streams, it combines them with the previous received bit streams and decompresses the "original" image. Due to modification of the original SPHIT transmission procedure, in phase 2 and 3, user can identify the image in earlier phase itself.

4. Experimental result :

The experimental results are analysed based on Bit rate, PSNR, MSE and Structural Similarity Index computation. To analyse the experimental results, we have used following formulas to calculate MSE, PSNR & SSI and are tabulated in Table1.

$MSE=\sum_{i=1}^{M}\sum_{j=1}^{N}\frac{(x\text{-}x1)^2}{M*N}$ 1

$PSNR=10\log_{10}\frac{255\ X\ 255}{MSE}$ db 2

SSI =ssim(Rec_Image, Orig_Image) ..3

A better experimental result will be obtained if the PSNR value is more. Otherwise, if the value is less, the resemblance will be less.

Table: 1Numerical result.

Bits Allocated	Bit Rate	PSNR	MSE	SSI
6553	0.1	25.96	164.62	0.36
13107	0.2	29.02	81.48	0.42
32768	0.5	33.82	26.93	0.48
45875	0.7	36.47	14.64	0.49
65536	1	39.86	6.71	0.52
131072	2	49.84	0.674	0.55

Conclusions:

A progressive medical image transmission based on transmitting significant coefficients in each transmission phase combining SPIHT &DWT with precision and rate control is implemented. In this technique it allows the user to decide whether subsequent transmission is required, instead of waiting for entire image transmission and reception. Thus the progressive image transmission can save the time and transmission bandwidth.

From the figure 1-3 we can observe that the PSNR values in the second and third phases are much greater than those of the proceeding phases, which allows the user at receiver side to decide whether further transmission is required is not. The Table.1 shows as the bits allocated increases experimental results also increases. The PSNR & MSE are at better range but SSI value is low. Thus it is better to adopt technique that enhances the SSI to an acceptable vale.

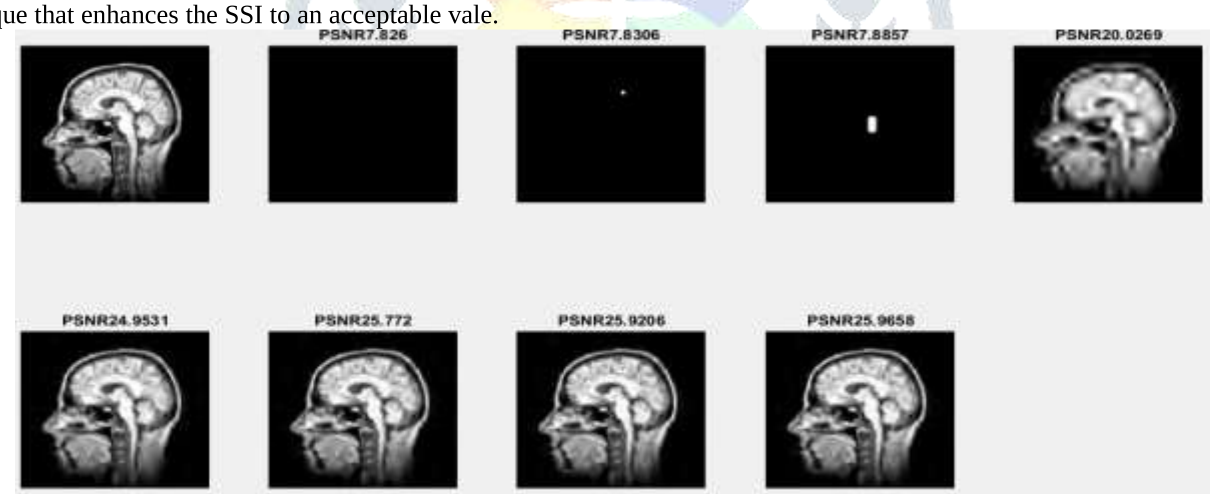

Fig1: Progressive Transmission and Reconstruction for Bit rate= 0.1

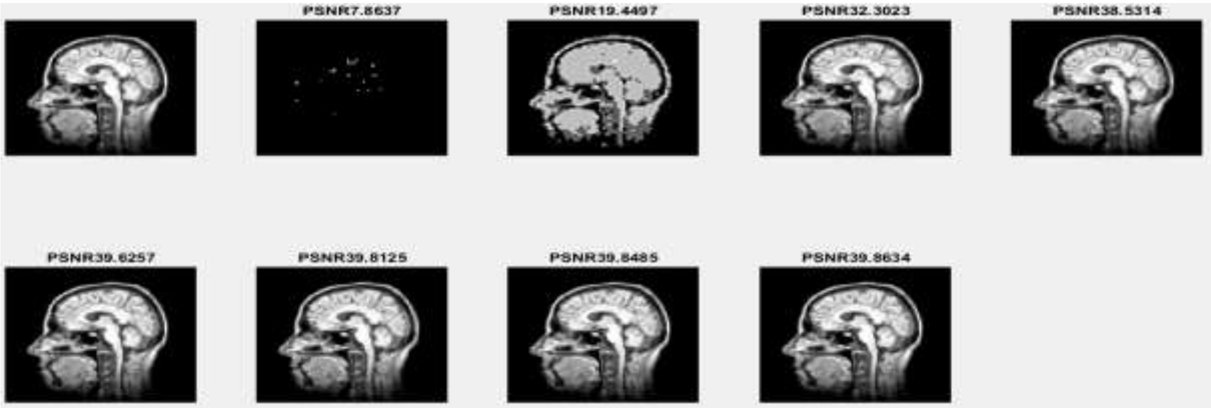

Fig2: Progressive Transmission and Reconstruction for Bit rate=1

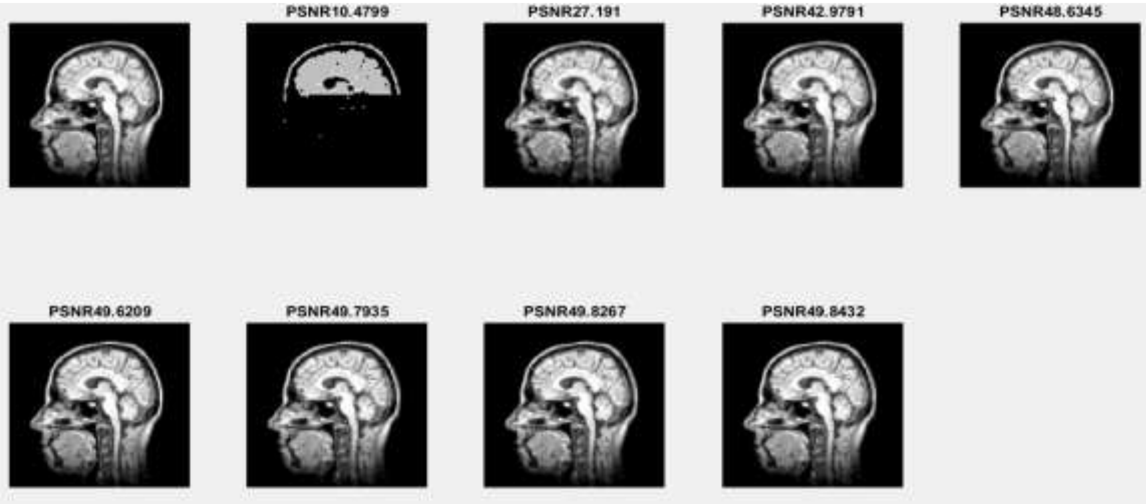

Fig3: Progressive Transmission and Reconstruction for Bit rate= 2

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