An Efficient Medical Image Compression By SPIHT And EZW Based On ROI And NROI Using Wavelet Decomposition

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Abstract

Recently, the wavelet transform has emerged as a cutting edge technology, within the field of image compression research. Telemedicine, among other things, involves storage and transmission of medical images, popularly known as Tele radiology. Due to constraints on bandwidth and storage capacity, a medical image may be needed to be compressed before transmission/storage. This paper is focused on selecting the most appropriate wavelet transform for a given type of medical image compression. In this paper an efficient method is proposed marks the ROI. The marked area of ROI is compressed using loss less compression and the other areas of the image are compressed using lossy wavelet compression techniques. The proposed procedure when applied on CT images, achieved an overall compression ratio of 70-92 % without loss in the originality of ROI.

Keywords: SPIHT (set partitioning in hierarchal trees), EZW (embedded zero tree wavelet), CT (computed tomography), MRI, DWT, PSNR, CR and RMSE.

1.INTRODUCTION

With the steady growth of computer power, rapidly declining cost of storage and ever increasing access to the Internet, digital acquisition of medical images has become increasingly popular in recent years. Medical imaging impacts medicine specially diagnosis and surgical planning. But imaging devices generate a large amount of data for each patient requiring storage and efficient transmission. Present compression schemes have high compression rates when quality loss can be afforded. But physicians cannot afford deficiencies in image regions which are important, known as regions of interest (ROIs). An approach which brings high compression rates accompanied by good quality in ROI's is needed.

Wavelet transform has been considered to be a highly efficient technique of image compression resulting in both lossless and lossy compression of images with great accuracy, enabling its use on medical images. On the other hand, in some areas in medicine, it may be sufficient to maintain high image quality only in the region of interest i.e. in diagnostically important regions. This paper proposes a framework for ROI based compression of medical images using wavelet based compression techniques. Results are analyzed by conducting the experiments on a number of medical images by taking different region of

2. WAVELET COMPRESSION

Wavelet transforms are based on small wavelets with limited duration. The translated-version wavelets locate where we concern. Whereas the scaled version wavelets allow us to analyze the signal in different scale. It is a transform that provides the time -frequency representation simultaneously.

2.1 DECOMPOSITION PROCESS

The image is high and low-pass filtered along the rows. The results of each filter are down sampled by two. Each of the sub-signals is then again high and low-pass filtered, but now along the column data and the results is again down-sampled by two. Hence, the original data is split into four sub-images each of size N/2 by N/2 and contains information from different frequency components. Fig. 2.1 shows the One Decomposition Step of the Two Dimensional Images. Fig 2.2 shows the block wise representation of decomposition step.

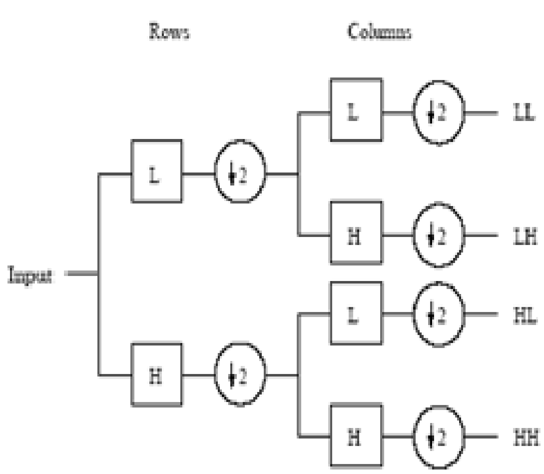

Figure 2.1: One Decomposition Step of the Two Dimensional Images

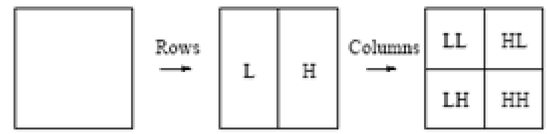

Figure 2.2: One DWT Decomposition Step

The LL sub band contains a rough description of the image and hence called the approximation sub band. The HH Sub band contains the high-frequency components along the diagonals. The HL and LH images result from low-pass filtering in one direction and high-pass filtering in the other direction. LH contains mostly the vertical detail information, which corresponds to horizontal edges. HL represents the horizontal detail information from the vertical edges. The sub bands HL, LH and HH are called the detail sub bands since they add the high-frequency detail to the approximation image.

2.2 Composition Process

The four sub-images are up-sampled and then filtered with the corresponding inverse filters along the columns. The result of the last step is added together and we have the original image again, with no information loss.

3. PROPOSED METHOD

In this proposed method we have analyzed the different medical images with different regions using SPIHT & EZW. SPIHT is a wavelet-based image compression coder. It first converts the image into its wavelet transform and then transmits information about the wavelet coefficients. The decoder uses the received signal to reconstruct the wavelet and performs an inverse wavelet transform to recover the image.

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4. EXPERIMENTAL RESULT

1. SPIHT in ROI and EZW in NROI

Decom-position level	PSNR	CR	CR (ROI)	CR (NROI)	BPP (ROI)	BPP (NROI)
2	42.33	82.86	98.57	67.16	7.88	5.37
4	45.26	67.14	72.35	61.93	5.78	4.95
6	42.78	48.59	56.70	40.49	4.53	3.23
8	42.78	48.59	56.70	40.49	4.53	3.23
10	42.78	48.59	56.70	40.49	4.53	3.23

Table1

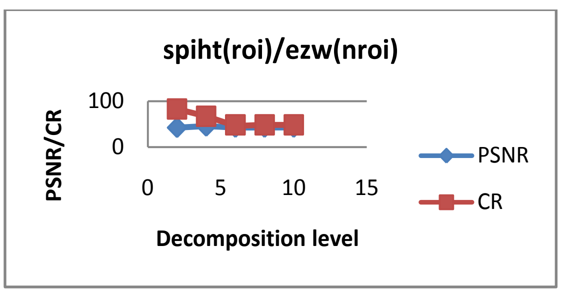


Fig 1.1

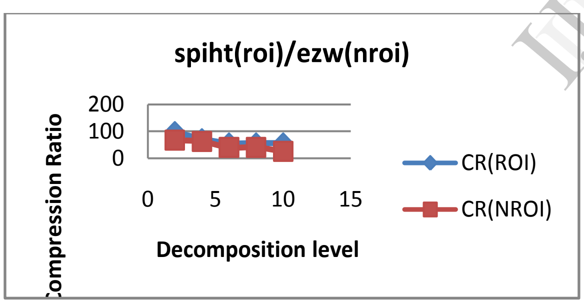


Fig 1.2

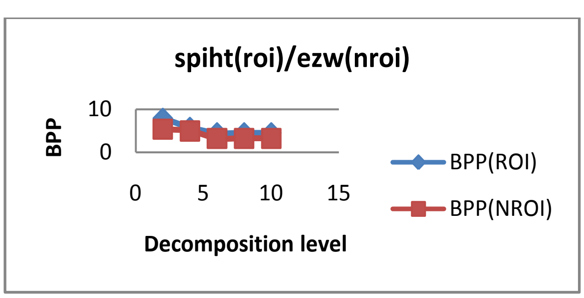


Fig 1.3

2. EZW in ROI and SPIHT in NROI

Decom-position level	PSNR	CR	CR (ROI)	CR (NROI)	BPP (ROI)	BPP (NROI)
2	42.33	92.65	129.52	55.77	10.36	4.46
4	44.70	78.68	121.92	35.45	9.75	2.83
6	42.01	58.00	90.16	25.85	7.21	2.06
8	42.01	57.97	90.16	25.78	7.21	2.06
10	42.01	57.97	90.16	25.78	7.21	2.06

Table 2

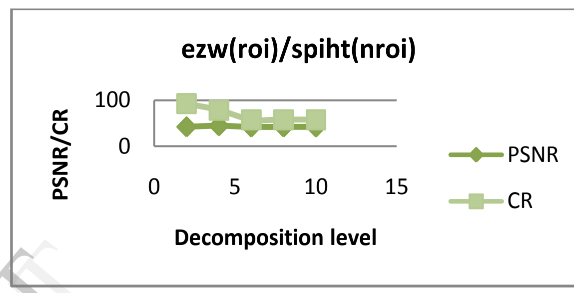
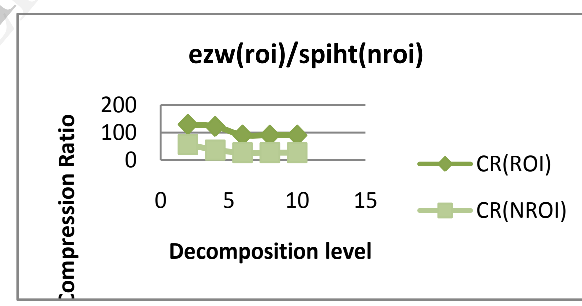


Fig 2.1



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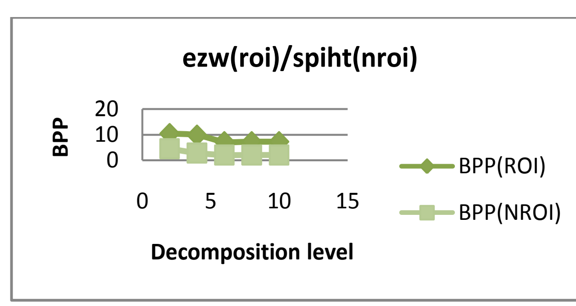


Fig 2.3

3. SPIHT in ROI and NROI

Decom-position level	PSNR	CR	CR (ROI)	CR (NROI)	BPP (ROI)	BPP (NROI)
2	43.70	81.37	102.12	60.61	8.16	4.84
4	45.13	56.51	73.80	39.21	5.90	3.13
6	42.11	43.48	58.05	28.90	4.64	2.31
8	37.77	38.94	58.05	19.83	4.64	1.58
10	37.77	38.94	58.05	19.83	4.64	1.58

Table 3

4. EZW in ROI and NROI

Decom - positio n level	PSNR	CR	CR (ROI)	CR (NROI)	BPP (ROI)	BPP (NR OI)
2	42.33	98.34	129.52	67.16	10.36	5.37
4	43.44	91.92	121.92	61.93	9.75	4.95
6	43.18	65.32	90.16	40.49	7.21	3.23
8	43.17	65.32	90.16	40.49	7.21	3.23
10	43.17	65.32	90.16	40.49	7.21	3.23

Table4

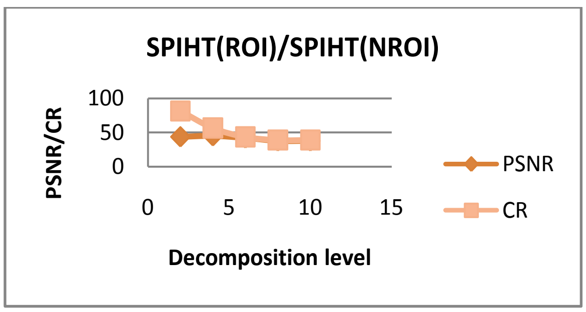


Fig 3.1

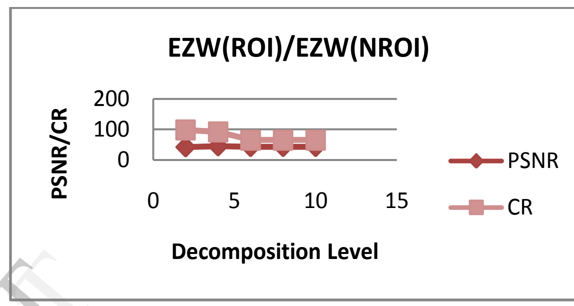


Fig 4.1

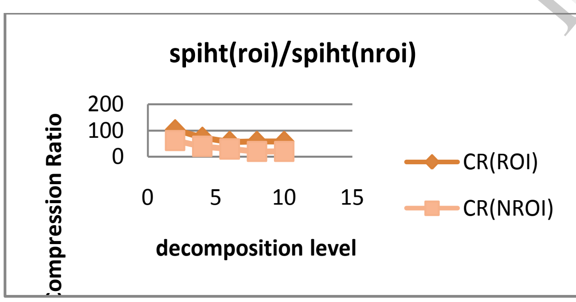


Fig 3.2

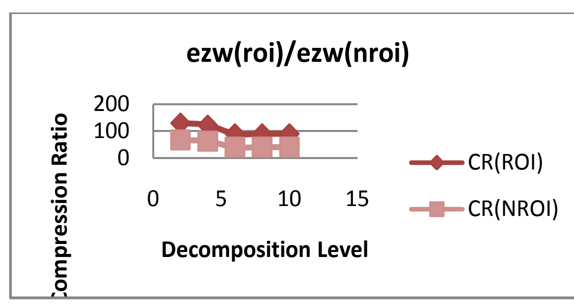


Fig 4.2

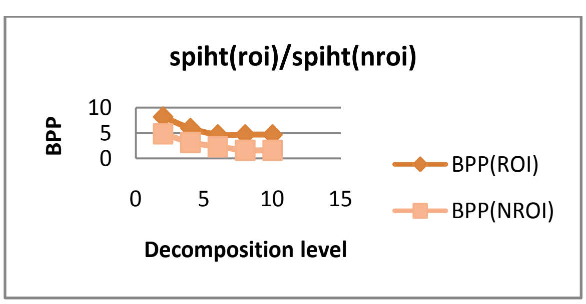


Fig 3.3

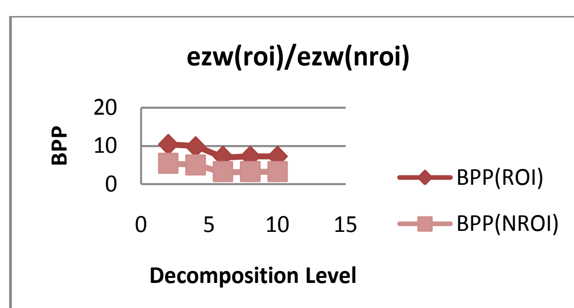
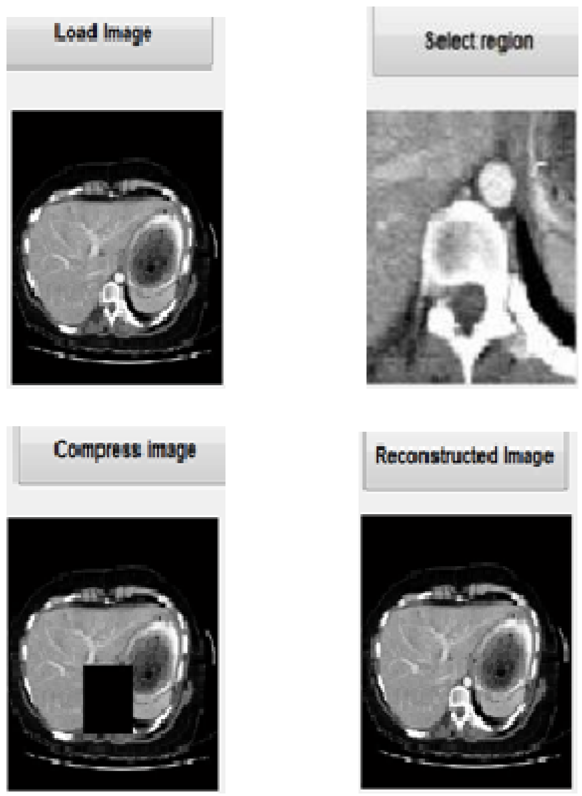


Fig 4.3

5. SIMULATION RESULT



6. DISCUSSION AND CONCLUSION

Image compression with SPIHT is very powerful for the medical images. Changing the decomposition level changes the detail in the decomposition. Thus at higher decomposition levels, higher compression rates can be achieved. The results of the already existing techniques are compared on the basis of coding efficiency, memory requirements, and image quality parameters. One of the important features of SPIHT is that it uses the progressive transmission and its use of embedded coding. Compression Algorithm not only raises the coding efficiency and reconstructed image quality. It also reduces the image encoding time. Therefore, in the field of medical image processing the proposed algorithm has a very broad application prospects.

From the result in the given tables and the graphs shows that SPIHT gives the better PSNR value as compared the existing method. These tables and graphs also show that the maximum four level of decomposition are most suitable, after that PSNR value are decreasing and after this level parameter values seems to be constant. So we can say that the fourth level of decomposition is best. From the result we obtain the maximum PSNR 45.26 at fourth level of decomposition using SPIHT in ROI and EZW in NROI and simultaneously we obtain the maximum PSNR 44.70 at fourth level of decomposition by using EZW in ROI and SPIHT in NROI.

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