Research on Medical Image Compression

Bhaskar .P [1], Amaranth .P [2], Vanaja .N [3], Rajasekhar .B [4]

[1] *Research Scholar, Department of CSE, Rayalaseema University, Kurnool-518002, A.P, INDIA.*
[2] *Assistant Professor, Department of MCA, JNIT, Hyderabad-501510, AP, INDIA.*
[3] *Assistant Professor, Department of CSE, CVR, Hyderabad-501510, AP, INDIA.*
[4] *Assistant Professor, Department of CSE, JNIT, Hyderabad-501510, AP, INDIA.*

Summary
This paper presents an approach for an Image compression Algorithm, EZW and SPIHT which is an extension of Shapiro's embedded Zero-tree Wavelet Algorithm. The proposed Partial EZW Algorithm overcomes the difficulty of EZW that loses its efficiency in transmitting lower bit planes. In this paper, we include integer wavelet transform and region of interest coding to Partial EZW & SPIHT and hence it make it more superior to EZW and SPHIT Algorithm and it is proved with the results.

Keywords:
Region of Interest, Wavelet, Spiht, Compression

1. Introduction

Increasingly, medical images are acquire and stored digitally. These images may be very large size, number and compression offers a means to reduce the cost of storage and increase the speed of transmission. Image compression is minimizing the size in bytes of a graphics file without degrading the quality of the image. The resolution in file size allows more images to be stored in a given amount of disk or memory space. It also reduces the time required for images to be sent over the Internet or download from WebPages. Several compression algorithms were developed. J.M Shapiro developed the embedded zero tree wavelet algorithm in which yields a fully embedded code and consistent compression. With embedded coding, It is possible to recover the lossy version with distortion corresponding to the rate of the received image at the point of decoding process. EZW and SPIHT is a progressive image compression algorithm. As quoted in EZW and SPHIT is found to have the drawback that the compression decreases during the transmission of least significant bits.

2. Overview of EZW Coding Algorithm

A sample block diagram of image compression system is shown in Fig.2.1.

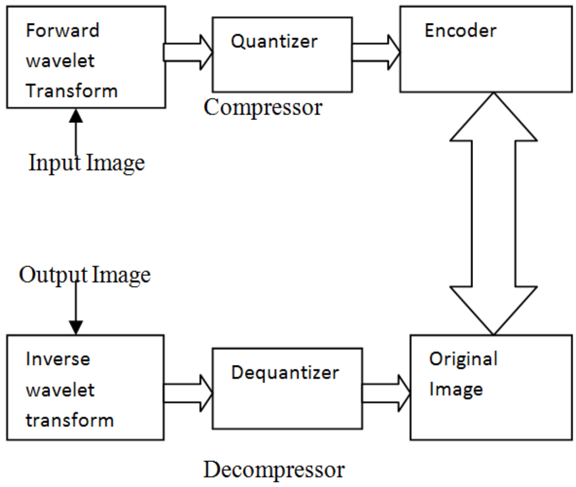

Figure 2.1: Block diagram of Image compression system.

One of the most important characteristics of DWT is multi resolution decomposition. An image decomposed by wavelet transform can be reconstructed with desired resolution. When first level 2D DWT is applied to an image, it forms four transform coefficients.
The first letter corresponds to applying either low pass or high pass filter to rows and the second letter refers to filter applied to columns. The elimination of high pass components by 2D wavelet transform technique reduces the computation time by reducing the number of arithmetic operations and memory accesses and communications energy by reducing the number of transmitted bits. With the increase in the levels of decomposition, the compression can be made sufficient correspondingly, the inverse DWT are performed in the decompression block.
A Quantizer simply reduces the number of bits needed to store the transformed coefficients by reducing the precision of those values. Since this is a many to one mapping, it is a lossy process and is the main source of compression in an encoder. In uniform quantization, quantization is performed on each individual coefficient. Among the various coding Algorithms, the embedded zero tree wavelet coding by have Shapiro and its improved

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version, the SPHIT by said and Pearlman been very successful. EZW/SPHIT are a progressive image compression algorithm i.e., at any moment, the quality of the displayed image is the best available for the no of bits received to the moment. Compared with JPEG the current standard for still image compression, the EZW and SPIHT are more efficient and reduce the blocking artifact. The EZW algorithm forms are a hierarchical quad tree data structure for the wavelet-transformed coefficients. The set of root node and corresponding descendents are referred to as a spatial orientation tree (SOT). The tree is defined in such way that each node has either no leaves or four offspring, which are from 2x2 adjacent pixels. The pixel on the LL sub image of the highest decomposition level is the tree roots and is also grouped in 2x2 adjacent pixels.

3. Integer Wavelet Transform

The Discrete Wavelet Transform (DWT) is a versatile signal processing tool that finds many engineering and scientific applications. One area in which the DWT has been particularly successful is in image compression and it has been adopted in upcoming JPEG2000 image compression standard. Recently the concept of lifting has thrown net insight and ideas on wavelets and has served to enhance the power and versatility of wavelet transforms. Lifting provides an efficient way to implement the DWT and the computational efficiency of the traditional direct convolution based implementation. The lifting approach is adopted in JPEG2000. The lifting scheme has also provided an easy way to construct new types of wave let transforms which can be nonlinear. The Integer Wavelet Transform (IWT) maps integers to integers and allows for perfect invariability with finite precision arithmetic. A simple and effective way to construct IWT is to first factor the traditional DWT into lifting steps to and than to apply a rounding operation at each step. The IWT can thus be based for losses compression for medical images. One of the main advantages of using the wavelet transform for compression is that it provides a multi resolution representation of the image which other techniques like spatial domain prediction cannot offer. The multi resolution representation allows the transmission of the lower resolution version of the image first, followed by transmission of successive. This mode of transmission is useful when the band width is limited and the image size is large, e.g., 2D and 3D medical images for telemedicine applications. The transmission can be stopped at the client end if it is deemed that the received image at the current resolution is sufficient or the image is not of interest at the user end. However a full resolution lossless version of the image can be received if so desired. Note that the IWT can also be used for lossy compression and it has certain advantages over the traditional DWT. The IWT can be used in a unified lossy and lossless code and a seamless transmission between virtually lossless and strictly lossless can be achieved the IWT also have the potential for simpler implementation as many of the operands are integer and hence widely used in compression systems in industries.

4. Proposed ROI-IWT Partial EZW/SPIHT Algorithm

The block diagram of encoder of part proposed RIO-IWT algorithm in given fig 4.1

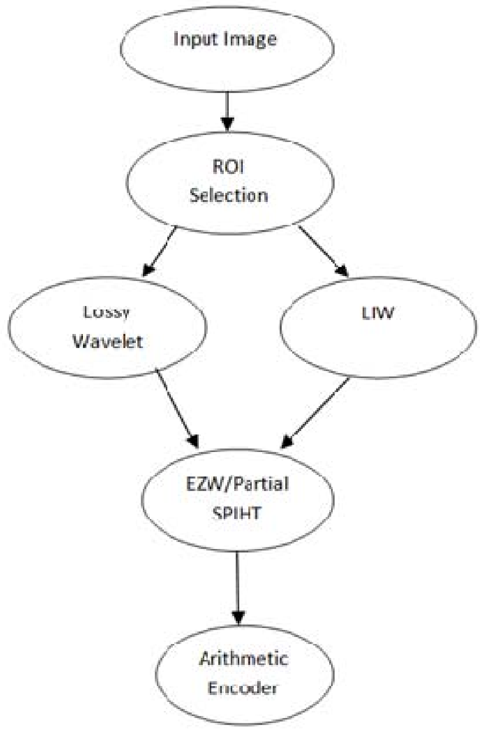

Fig 4.1. ROI-IWT Partial EZW/SPIHT Encoder

ROI coding is one of the most important features provided by JPEG-2000. It allows, imposing heterogeneous fidelity constraints to different regions of the image rather than encoding the entire image as a single entity. This property is especially useful for image coding applications, where the image consists of regions that can be encoded at different bit rates, such as compression of medical images. For medical images, the diagnostically significant information is localized over relatively small regions of interest. In this case, region-based coding for better utilization of the available bit rate since the high quality should be maintained only for the aforementioned diagnostically significant regions and the rest of the image can be encoded at a lower bit rate.

Once the region of interest is selected efficiently, the significant region is transformed using lossless integer wavelet transform filter and diagnostically unimportant region with lossy Daubechies 5/3 tap filter. Then the transformed images are encoded using partial EZW and

SPIHT algorithm, introduced by Abu Hajar and Ravi Shankar in. It is based on the frequency of once it in each plane. It uses conventional EZW when the frequency of one's is less than 0.2 and two new options are used otherwise. Option_1 is used for the frequency of the one's is less than 0.3 and option_2 is used if it is grater than 0.3.The output of partial EZW/SPIHT encoder is an coded with arithmetic encoder to reduce the redundancy further and to improve the efficiency of compression. The block diagram of decoder part of proposed ROI-IWT algorithm is given fig 4.2.

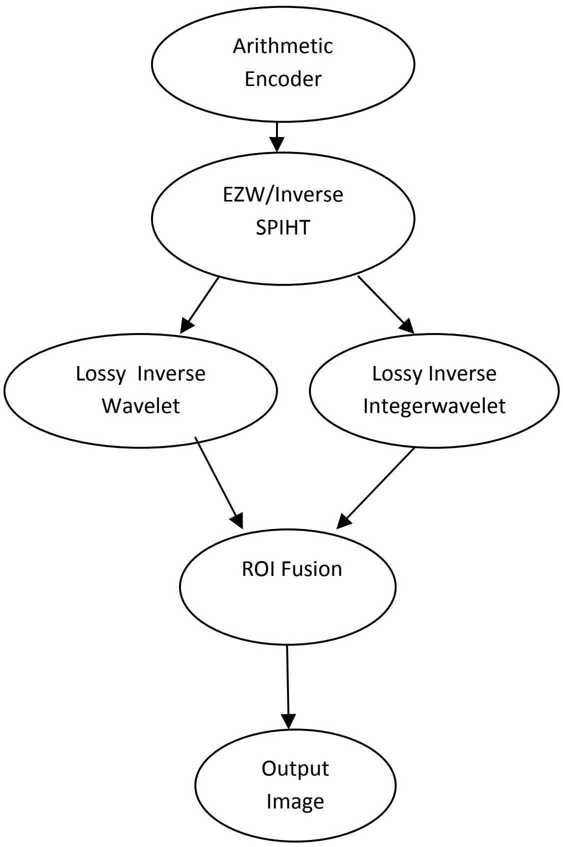

Fig 4.2. ROI-IWT Partial EZT/SPHIT Decoder

5. Simulation Results

An 8-bit 512x512 images were tested to evaluate the performance of the ROI-based PEZW/SPIHT CODER. In order to evaluate the order effectively, the same ROI region, the same ROI region is used for all the tested images. The ROI region has a circular region shape and its center is located in the middle of the image, and ROI region is coded using the integer wavelet transform filter and the back ground is coded lossy using Daubechies 5/3 tap filter. It occupies ratio for ROI-partial EZW/SPIHT increase than the proposed algorithm is shown in table 5.1.

S.No	EZW		SPIHT	
	PSNR	CR	PSNR	CR
CT	37.15	5:7	38.55	8:5
MRI	39.21	8:6	36.34	15.5

Table 5.1. PSNR and CR for EZW and SPIHT

6. Conclusion

In this paper, ROI-based P-EZW and SPIHT was proposed which is capable of coding each arbitrary shape ROI regions independently. The compression of the proposed algorithm is superior to EZW for lossy as well as lossless coding. Our coder proves in terms of PSNR and CR.

References

[1] A. Abu-Hajar and R. Shankar, "Enhanced Partial-SPIHT for Lossless Image Compression" Acoustics, speech and signal processing, 2003.

[2] ShapiroJM, "Embedded image coding using zero tree of wavelet coefficients", IEEE Trans signal processing, 1993

[3] A. Abu-Hajar and R. Shankar, "Wavelet based lossless image compression using partial SPIHT and bit plane based arithmetic coder", ICASSP 2002; 4:3497-3500.

[4] Peng Jiang, Qingbo Huang, Yaguang Kang and Li Chai, "Research on compression method based on IWT and SPIHT for historical Data in Process Industry", Computer and computational sciences 2006, Proceedings (IMSCCS '06).

P. Bhaskar is an Associate Professor in Computer Science and Engineering Department at Jawaharlal Nehru Institute of Technology, Hyderabad, India. He holds Bachelor's degree in Computer Science (BSC), Masters Degree in Computer Applications (MCA) and Masters Degree in Computer Science Engineering & Technology (M.Tech).He published three papers in National Conference, International Conference and International Journal. He has memberships of LISTE,MCSI and LMIETE. He is working towards PhD degree in Computer Science and Engineering in the field of image processing from Rayalaseema University, Kurnool, India.

P.Amaranth is an Assistant Professor in ComputerScience and Engineering Department at Jawaharlal Nehru Institute of Technology, Hyderabad, India. His areas of interests are Data mining and Data warehouse, Data base management systems, Computer Networks, Operating Systems. He published papers in national conference and international Journals.

N.Vanaja is an Assistant Professor in Computer Science and Engineering Department at CVR Engineering College, Hyderabad, India. His areas of interests are Data mining and Data warehouse, Data base management systems.

B. Rajasekhar is an Assistant Professor in Computer Science and Engineering Department at Jawaharlal Nehru Institute of Technology, Hyderabad, India. His areas of interests are Data mining and Data warehouse, Data base management systems, Computer Networks, Operating Systems. He published papers in national conference and international Journals.