Wavelet Transform Along with SPIHT Algorithm used for Image Compression

Navesh Sallawar[1], Nilesh Bodne[2]

[1]Student, Department of Electronics & Communication Engineering Vidhrbha Institute of Technology Nagpur
[2]Professor, Department of Electronics & Communication Engineering Vidhrbha Institute of Technology Nagpur

---

Abstract – we use image processing *In the coming of era the digitized image is an important challenge to deal with the storage and transmission requirements of enormous data, including medical images. Compression is one of the indispensable techniques to solve this problem. In this paper, we propose an algorithm for medical image compression based on lifting base wavelet transform coupled with SPIHT (Set Partition in Hierarchical Trees) coding algorithm, of which we applied the lifting structure to improve the drawbacks of conventional wavelet transform. We compared the results with various wavelet based compression algorithm. Experimental results show that the proposed algorithm is superior to traditional methods for all tested images at low bit rate. Our algorithm provides better PSNR, Quality factor and MSSIM values for medical images only at low bit rate. Compressed image can be represent in various format such as GIF, JPG, BMP and PNG*

Key Words: SPIHT, Lifting scheme, Entropy coding, Compression, wavelet.

1. INTRODUCTION:

Medical images needs large volume of storage space especially volumetric medical images such as computed tomography (CT) , positron emission tomography(PET) images, magnetic resonance (MR) images and ultrasound images. The quantity of data produced by these techniques is enormous and they utilize maximum bandwidth for transmission that often results in degradation of image quality. This might causes a crisis when sending the data for high quality diagnostic applications such as telemedicine, teleradiology and teleconsultation over a network. Also, they are needed to be stored in picture archiving and communication system (PACS) or hospital information system (HIS).It is very tricky for the hospitals to manage the storage facilities for these volumetric images which affects mass storage and fast communication.. Thus image detract plays a important role in these applications. Hence squeezing of medical images is an emerging need for storage of medical imaging and for fast communication system.

To optimizes the above requirement lifting based wavelet transform coupled with modified SPIHT encoding algorithm gives better squeezing results with good quality of Image. During this process, the input image is decomposed into wavelet coefficients using Lifting Based Discrete Wavelet Transform and the resultant form is encoded using SPIHT algorithm with certain modifications based on prior scanning of the coefficients.

1.1 SPIHT

SPIHT is Set Partitioning In Hierarchical Trees. It is the wavelet based compression coder. It divides the wavelet into Spatial Orientation Trees. SPIHT codes a wavelet by transmitting information about the significance of a pixel. It is a method of coding and decoding the wavelet transform of an image.

1.2 Implementation of SPIHT:

The basic principle is progressive coding which process the image respectively to a lowering threshold. First step, the original image is decomposed into sub bands. Then the method finds the maximum iteration number. Second, the method puts the DWT coefficients into a sorting pass that finds the significance coefficients in all coefficients and encodes the sign of these significance coefficients. Third, the significance coefficients that can be found in the sorting pass are put into the refinement pass that uses two bits to exact the reconstruct value for approaching to real value [1]. The result is in the form of a bit stream. It has three lists to store the values. They are List of Insignificant Pixels (LIP), List of Significant Pixels (LSP), and List of Insignificant Sets (LIS).

2. WAVELET TRANSFORM

The wavelet Lifting Scheme is a method for decomposing wavelet transforms into a set of stages. Lifting scheme algorithms have the advantage that they do not require temporary arrays in the calculations steps and have less computation

A. Spliting:

In this stage the input signal is divided in to two disjoint sets, the odd (X[2n+1]) and the even samples (X[2n]).

B. Lifting:

In this module, the prediction operation P is used to estimate X0(n) from Xe (n) and results in an error signal d(n). Then we update d (n) by applying it to the update operation U, and the resulting signal is combined with Xe(n) to S(n) estimate, which represents the smooth part of the original signal.

C. Scaling:

A normalization factor is applied to d(n) and s(n), respectively. In the even-indexed part S(n) is multiplied by a normalization factor Key to produce the wavelet sub-band XL1. Similarly in the odd-index part the error signal d(n) is multiplied by K0 to obtain the wavelet sub band XH1. The output result is XL1 and XH1 by using the lifting-based WT are the same as those of using the convolution approach for the same input. For lifting implementation, the CDF 9/7 wavelet filter pair can be factorized into a sequence of primal and dual lifting. The most efficient factorization of the poly phase matrix for the 9/7.

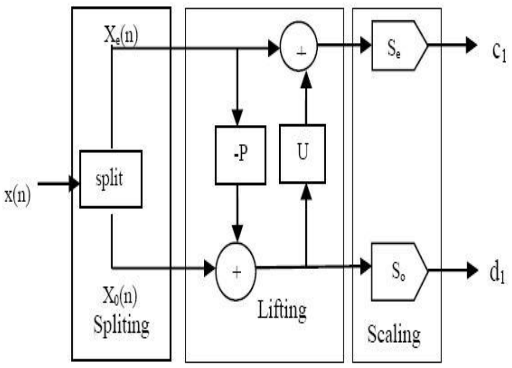

Fig -1: The lifting-based Wavelet Transform

principle is the same; a progressive coding is applied, processing the image respectively to a lowering threshold. The difference is in the concept of zero trees (spatial orientation trees in SPIHT). There is a coefficient at the highest level of the transform in a particular sub band which considered insignificant against a particular threshold; it is very probable that its descendants in lower levels will be insignificant too. Therefore we can code quite a large group of coefficients with one symbol. A spatial orientation tree is defined in a pyramid constructed with recursive four sub bands splitting. According to this relationship, the SPIHT algorithm saves many bits that specify insignificant coefficients.

The flowchart of SPIHT is presented in Fig.2 as a First step the original image is decomposed into sub bands. Then the method finds the maximum iteration number. Second, the method puts the DWT coefficients into a sorting pass that finds the significance coefficients in all coefficients and encodes

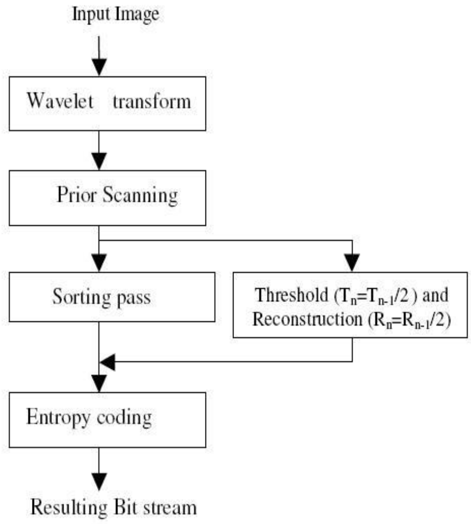

Fig -2: Flow chart of SPIHT coding scheme

3. SPIHT CODING SCHEME

SPIHT (Set Partition in Hierarchical Trees) is one of the most advanced schemes, even outperforming the state-of-the art JPEG 2000 in some situations. The basic principle is the same; a progressive coding is applied, processing the image respectively to a lowering threshold. The difference is in the concept of zero trees (spatial orientation trees in SPIHT). There is a coefficient at the highest level of the transform in a particular sub-band which considered insignificant against a particular threshold; it is very probable that its descendants in lower levels will be insignificant too. Therefore we can code quite a large group of coefficients with one symbol. A spatial orientation tree is defined in a pyramid constructed with recursive four sub bands splitting. According to this relationship, the SPIHT algorithm saves many bits that specify insignificant coefficients.

The flowchart of SPIHT is presented in Fig.3 as a First step the original image is decomposed into sub bands. Then the method finds the maximum iteration number. Second, the method puts the DWT coefficients into a sorting pass that finds the significance coefficients in all coefficients and encodes

4. CONCLUSION

The objective of this paper is undoubtedly the improvement of medical images quality after the compression step at low bit rate. The latter is regarded as an essential tool to aid diagnosis (storage or transmission) in medical imaging. We used the CDF Lifting based wavelet transform, coupled with the SPIHT coding. After several applications, we found that this algorithm gives better results than the other compression techniques only at low bit rate.To develop our algorithm, we have applied this technique on different types of medical images. We have noticed that for 0.75 bpp bit-rate, the algorithm provides better PSNR and MSSIM values for various medical images. In future this algorithm can use for all bit rates by modifying it. Thus, we conclude that the results obtained are very satisfactory in terms of compression ratio and compressed image quality only at low bit rate.

REFERENCES

[1]. S. Mallat: Multifrequency Channel Decompositions of Images and Wavelet Models, IEEE Transaction in Acoustic, Speech and Signal Processing, Vol. 37, No. 12, Dec. 1989, pp. 2091 – 2110.

[2]. Daubechies, W. Sweldens: Factoring Wavelet Transforms into Lifting Steps, Journal of Fourier Analysis and Applications, Vol.4, No. 3, May 1998, pp. 247 – 269.

[3]. ParvinderKaur: Compression Using Fractional Fourier Transform a Thesis Submitted in the partial fulfillment of requirement for the award of the degree of Master of Engineering In Electronics and Communication.

[4]. Florian Achleitner, Philipp Miedl: Filter Structures for FIR filters, Conference Paper - Graz University of Technology - January 2, 2011.

[5]. A. Mallaiah, S. K. Shabbir, T. Subhashini: An Spiht Algorithm With Huffman Encoder For Image Compression And Quality Improvement

Using Retinex Algorithm, International Journal Of Scientific & Technology Research Volume 1, Issue 5, June 2012, ISSN 2277-8616, 45 IJSTR©2012, www.ijstr.org.

[6]. Yen-Yu Chen: Medical image compression using DCT-based sub-band decomposition and modified SPIHT data organization, International journal of medical informatics 76 (2007) 717–725, journal homepage:
www.intl.elsevierhealth.com/journals/ijm.