www.ijecs.in
International Journal Of Engineering And Computer Science ISSN:2319-7242
Volume 3 Issue 6 June, 2014 Page No. 6458-6464

An Effective Algorithm For Image Compression Using SCWP

Mrs. Malashree G, Mrs.Rehna V J
4th Sem M.Tech, Dept.of ELECTRONICS
HKBK College of Engineering
Bangalore, INDIA
dimpu213@ gmail.com
Proffesor, ,Dept.of ELECTRONICS
HKBK College of Engineering
Bangalore, INDIA
rehna_vj@yahoo.co.in

Abstract— In the conventional sub band /wavelet decomposition is performed on the spatial-domain image. But here may be using a decomposition Technique where the sub band decomposition is performed on the global DCT spectrum of the image. That is, the two-dimensional spectrum rather than the image is represented by a sum of basis functions, each weighted by the transform coefficients. The spectral sub band decomposition is then used as the basis for a new image coder, building on the spectral condensed wavelet packet (SCWP) algorithm. Ironically, this method is may expected to have lower arithmetic complexity than conventional sub band/wavelet coders that directly decompose a time or spatial domain signal. This new method may have lower complexity and higher compression performance.image coding, the sub band.

Index Terms— Condensed wavelet packets, decomposition of spectrum, overlapped block transform, sparse transform for coding and compressive sampling/compressed sensing.

I. Introduction

Visual information plays an important role in almost all areas of our life. Due to the vast amount of data associated with images, compression is a key technology. A digital image is a representation of a two-dimensional image as a finite set of digital values, called picture elements or pixels, digitization implies that a digital image is an approximation of a real scene . Pixel values typically represent gray levels, colours, heights, opacities etc. Digital image processing focuses on two major tasks :Improvement of pictorial information for human interpretation and Processing of image data for storage, transmission and representation for autonomous machine perception.

Sparse transforms have received much attention over the years because of their ability to decorrelate signals and provide a compact representation. As a result, they have played an important role in image processing, most notably in signal coding and compressive sampling. Such transforms include DCTs [9], DFTs [9], LOTs and lapped transforms [6], GenLOTs [7], and wavelet transforms [2], [3]. Conventional subband/wavelet transforms tsypically involve multirate filtering, downsampling, and upsampling of a spatial domain signal, such as a natural image. In this paper, we consider the dual scenario where by the DCT spectrum of the image is used as the input to the subband/wavelet transform for the purpose of obtaining a compact signal representation.

II. Literature Survey

Early 1920s: One of the first applications of digital imaging was in the news paper industry:

- The Bartlane cable picture transmission service

- Images were transferred by submarine cable between London and New York
- Pictures were coded for cable transfer and reconstructed at the receiving end on a telegraph printer.

Mid to late 1920s: Improvements to the Bartlane system resulted in higher quality images

- New reproduction processes based on photographic techniques
- Increased number of tones in reproduced images

1960s: Improvements in computing technology and the onset of the space race led to a surge of work in digital image processing.
1964: Computers used to improve the quality of images of the moon taken by the *Ranger 7* probe Such techniques were used in other space missions including the Apollo landings.
1970s: Digital image processing begins to be used in medical applications.
1979: Sir Godfrey N. Hounsfield & Prof. Allan M. Cormack share the Nobel Prize in medicine for the invention of tomography, the technology behind Computerised Axial Tomography (CAT) scans.
1980s - Today: The use of digital image processing techniques has exploded and they are now used for all kinds of tasks in all kinds of areas

- Image enhancement/restoration
- Artistic effects
- Medical visualisation
- Industrial inspection
- Law enforcement
- Human computer interfaces .

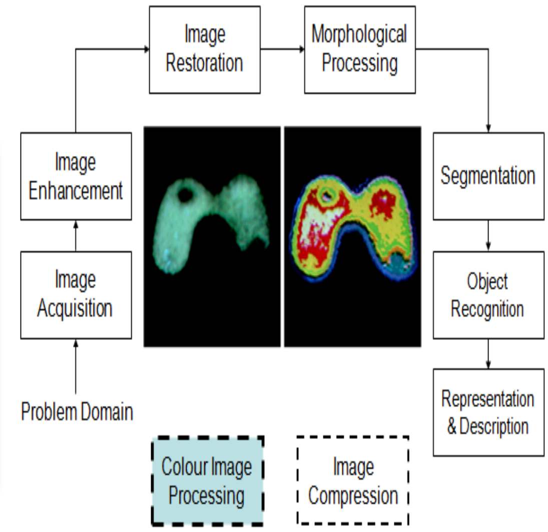


Figure 2..1 Key Stages in Digital Image Processing.

Image compression is the process by which the amount of data required to represent an image/audio/text/video is reduced by exploiting the redundancy in the image data. image compression algorithm can be basically classified into lossless and lossy compression JPEG is the most popularly used compression technique which is based on Discrete cosine transforms(DCT), JPEG compression technique involves three steps namely DCT Quantization and Variable length Coding [20], [21].
Many techniques have been developed so far to enable compression which involves DCT, JPEG2000, DWT, EZW, SPIHT, GW, PRUNING TREE, BSP.
In recent years, there has been increasing important requirement to address the bandwidth limitations over communication networks. The advent of broadband networks (ISDN, ATM, etc) as well as compression standards such as JPEG, MPEG, etc is an attempt to overcome that's limitations. With the use of more and more digital stationary and moving images, huge amount of disk space is required for storage and manipulation purpose. Image compression is very important in order to reduce storage need.

Sparse transforms have received much attention over the years because of their ability to de correlate signals and provide a compact representation. As a result, they have played an important role in image processing, most notably in signal coding and compressive sampling. Such transforms include DCTs [9], DFTs [9], LOTs and lapped transforms [6], Gen LOTs [7], and wavelet transforms [2], [3]

Discrete cosine Transforms (DCT) is the conventional image compression methodology, used over several decades, and it is found to be an efficient image compression algorithm. This is followed by encoding. Then the original image is reconstructed by using IDCT. Redundancies in video sequence can be removed by using Discrete Cosine Transform (DCT) and Discrete Wavelet Transform (DWT). DCT suffers from the negative effects of blackness and Mosquito noise resulting in poor subjective quality of reconstructed images at high compression. Hence we move towards DWT.

Wavelet techniques represents real life non stationary signal which is powerful technique for achieving compression. In order to meet the real time requirements, in many applications, design and implementation of DWT is required.

Wavelet is a small wave whose energy is concentrated in time. Properties of wavelets allow both time and frequency analysis of signals. The Discrete Wavelet Transform (DWT), which is based on sub-band coding, is fast computation of Wavelet Transform. It is easy to implement and reduces the computation time and resources required.

"Spectrum Decomposition for Image/Signal Coding"is a journal published in 'IEEE TRANSACTIONS ON SIGNAL PROCESSING, VOL. 61, NO. 5, MARCH 1, 2013' by

Jianyu Lin and Mark J. T. Smith

In this paper a decomposition where the subband decomposition is performed on the global DCT spectrum of the image. That is, the two-dimensionalspectrum rather than the image is represented by a sum of basis functions, each weighted by the transform coefficients. The distinct features of this decomposition are analyzed from a transform perspective. This spectral subband decomposition is then used as the basis for a new image coder, building on the condensed wavelet packet (CWP) algorithm. Ironically, this new method is shown to have lower arithmetic complexity than conventional subband/wavelet coders that directly decompose a time or spatial domain signal.

"A Progressive Transmission Image Coder Using Linear Phase Uniform Filterbanks as Block Transforms" is published in 'IEEE TRANSACTIONS ON IMAGE PROCESSING, VOL. 8, NO. 11, NOVEMBER 1999' by Trac D. Tran and Truong Q. Nguyen.

This paper presents a novel image coding schemeusing M-channel linear phase perfect reconstruction filterbanks (LPPRFB's) in the embedded zerotree wavelet (EZW) frame work introduced by Shapiro.

DISCRETE WAVELET TRANSFORM

Discrete Wavelet transform (DWT) is a mathematical tool for hierarchically decomposing an image. It is useful for processing of non-stationary signals. The transform is based on small waves, called wavelets, of varying frequency and limited duration. Wavelet transform provides both frequency and spatial description of an image. Unlike conventional Fourier transform,

temporal information is retained in this transformation process. Wavelets are created by translations and dilations of a fixed function called mother wavelet. This section analyses suitability of DWT for image watermarking and gives advantages of using DWT as against other transforms.

Characteristics of DWT

1. Wavelet Transform is computationally efficient and can be implemented by using simple filter convolution.
2. With multi-resolution analysis, image can be represented at more than one resolution level. Wavelets allow image to be described in terms of coarse overall shape and details ranging from broad to narrow.
3. Magnitude of DWT coefficients is larger in the lowest bands (LL) at each level of decomposition and is smaller for other bands (HH, LH, HL).
4. The larger the magnitude of wavelet coefficient, the more significant it is.
5. Watermark detection at lower resolutions is computationally effective because at every successive resolution level, less no. of frequency bands are involved.
6. High resolution sub bands help to easily locate edge and textures patterns in an image.

III. EXISTING SYSTEM

Image compression techniques, especially non reversible or lossy ones, have been know to grow computationally more complex as they grow more efficient, conforming the tenets of source coding theorems in information theory that a code for a source approaches optimally in the limit of infinite computation (source length).notwithstanding, the image coding technique called embedded zero tree wavelet (EZW), simultaneous progression of efficient any complexity. this technique not only was competitive in performance with the most complex techniques, but was extremely fast in the execution and produced and embedded bit stream. With an embedded bit stream .the reception of code bits can be stopped at any point and the image can be decompressed and reconstructed. Following that significant work, we developed an alternative exposition of underlying principles of the EZW technique and presented an extension that achieved even better result.

Advantage of Existing System

- Exploration of the self similarity of the image wavelet transform across different scales.

Disadvantage of Existing System

- In this arithmetic coding of the bit stream is essential to compress the ordering the final information.

IV. Proposed System

In conventional subband/wavelet image coding, the subband decomposition is performed on the spatial-domain image. Here, we introduce a novel decomposition where the subband decomposition is performed on the global DCT spectrum of the image.

- That is, the two-dimensional spectrum rather than the image is represented by a sum of basis functions, each weighted by the transform coefficients.
- The distinct features of this decomposition are analyzed from a transform perspective.
- This spectral subband decomposition is then used as the basis for a new image coder, building on the condensed wavelet packet (CWP) algorithm.

Proposed Technique CWP Decomposition

The CWP is a sparse transform for image compression. It employs a cyclic frequency domain implementation that incorporates time-domain symmetric extension. To summarize the key elements of a basic two-band split,

- Filter (frequency domain Multiplication)
- Down sampling operation through overlapped addition.
- Converting back to the time domain.

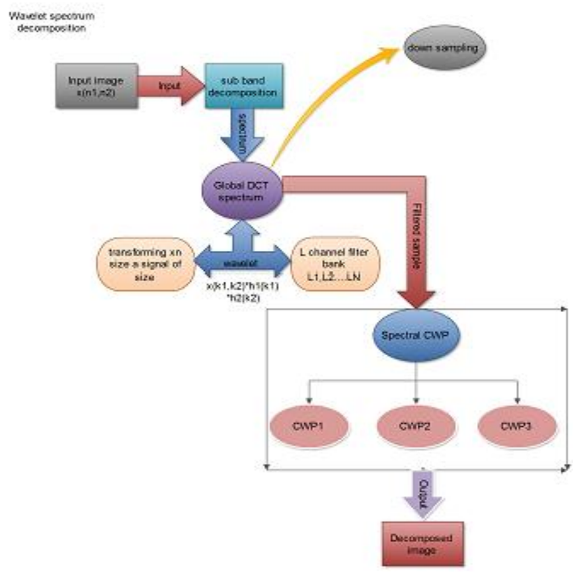
Advantage Of Proposed System

- The DCT spectrum of a natural image.
- DCT has the same size as the original image, and it is not particularly sparse since the bases of a large- DCT are not localized.
- A compact representation that can be coded efficiently using conventional subband/wavelet quantization and coding algorithms.

Objective

- Conventional subband/wavelet transforms typically involve multirate filtering, downsampling, and upsampling of a spatial domain signal, such as a natural image.
- We consider the dual scenario whereby the DCT spectrum of the image is used as the input to the subband/wavelet transform for the purpose of obtaining a compact signal representation.
- That is, instead of the image, its global DCT spectrum is decomposed by a set of bases, or equivalently, is represented by a sum of basis functions, each weighted by a transformed coefficient.

V. System Architecture



As described above, the spectrum decomposition involves first computing the global DCT spectrum X (k), followed by a subband decomposition. That is, the subbands coefficients, denoted $Y_l(m)(0 \leq l \leq L-1,\ 0 \leq m \leq M-1)$, are obtained by L -factor down sampling the convolution result X (k)* $h_l(k)$,where"* " denotes convolution and L x M = N . Thus, a total of L subbands of size M are obtained. We call $Y_l(m)$the subbands from the spectrum decomposition, the spectrum subbands, in order to distinguish them from the conventional signal decomposition subbands (or some reconfigured subbands of the conventional time/spatial domain interpretation).

By inspection it is evident that the filtering operations are isolating, as regions of support, contiguous L time/spatial blocks of the original signal .The resulting spectrum subbands, from the decomposition of correspond to the time/spatial blocks indexed by . Because spectrum subbands are decimated versions of which are the filtered output of ,then in the region close to m = 0 , spectrum subbands are composed offiltered samples from the neighborhood of and they contain low frequency information of the original signal. Similarly, spectrum subbands contain high frequency information of the original signal in the region close to m = M-1 . Thus, by rearranging the samples, subbands with the conventional time/spatial domain interpretation canb constructed. Specifically, new subband images can be performed by creating M subbands denotedeach of size L ,whereThese new reconfigured subbands which are of the conventional time/spatial domain interpretation, embody properties favorable for compression methods like the SPIHT algorithm [10]

VI. Algorithm Of The Spectrum Decomposition With The CWP

Suppose $x^P(n)$ (n=0,1,2,…..N-1) is a sub band signal at pth level p=0,1,2,….N-1

Then

1) $X(k)=DCT(x^P(n))$, k=o,1,…(N-1)
2) After filtering (via frequency domain) we obtain

   $U_l(k)=H_r(\pi k/N) . X(k)$

   $U_h(k)=G_r(\pi k/N).X(k)$

   k=0,1,…(N-1)

Where $U_l(k)$ and $U_h(k)$ are the output magnitude spectra from the low-pass and high-pass filters respectively .

$H_r(w)$ and $G_r(w)$ are the real components of the frequency responses of the low-pass and high-pass filters.

Now performing the down-sampling, we will get $X_l(k)$ and $X_h(k)$

Converting back to the time domain,

$x_l^{p+1}(n)=IDCT (X_l(k))$

$x_h^{p+1}(n)=IDCT (X_h(k))$

where $x_l^{p+1}(n)$ and $x_h^{p+1}(n)$ are low frequency and high frequency sub band.

At the receiver side

Reconstruction algorithm is governed by the following the steps

Assuming $x_l^{p+1}(n)$

and $x_h^{p+1}(n)$ are the sub band coefficients at the(p+1) level then,

1) $X_l(k)=DCT \{ x_l^{p+1}(n) \}$

$X_h(k) = DCT \{ x_h^{p+1}(n) \}$

After up-sampling we obtain

$V_l(k)= X_l(k)$

$V_h(k)=X_h(N/2-k)$

2) After filtering we obtain

$R_l(k)= H_r(\pi k/N). V_l(k)$

$R_h(k)=G_r(\pi k/N). V_h(k)$ k=0,1,….(N-1)

Combining the channel results in

$X(k) = R_l(k) + R_h(k)$ k=0,1,…(N-1)

3) Finally converting back to the time domain yields

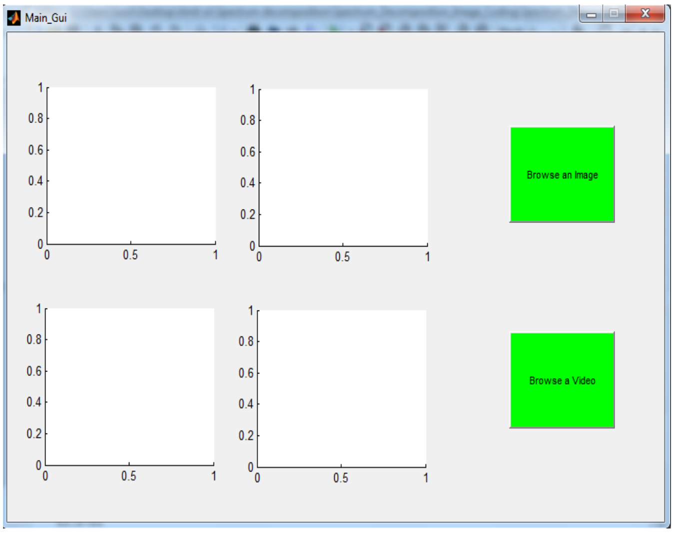
$x^P(n) = IDCT \{X(k)\}$ n=0,1,….(N-1)

VII. System Implementation

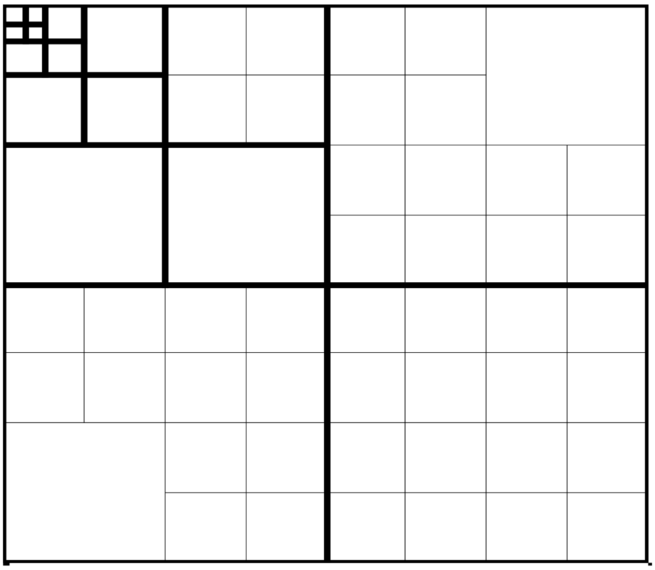
The implementation of the proposed system will require a standard cover image along with a normal plain text file for performing the message embedding procedure. However the software requirements for performing the implementation will be:

- The software chosen for the implementation of this project is Matlab2009.

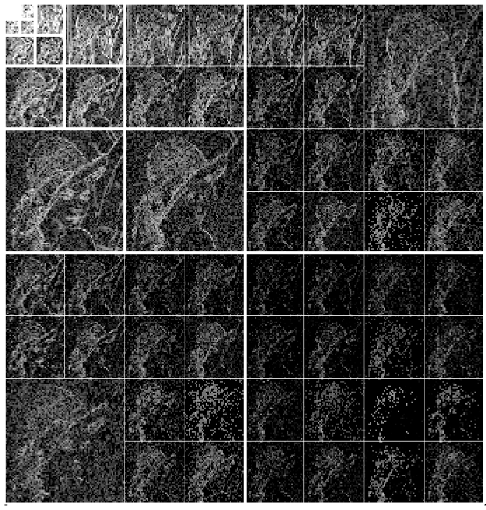
The operating system used will be either Microsoft Windows XP, Vista, 7.



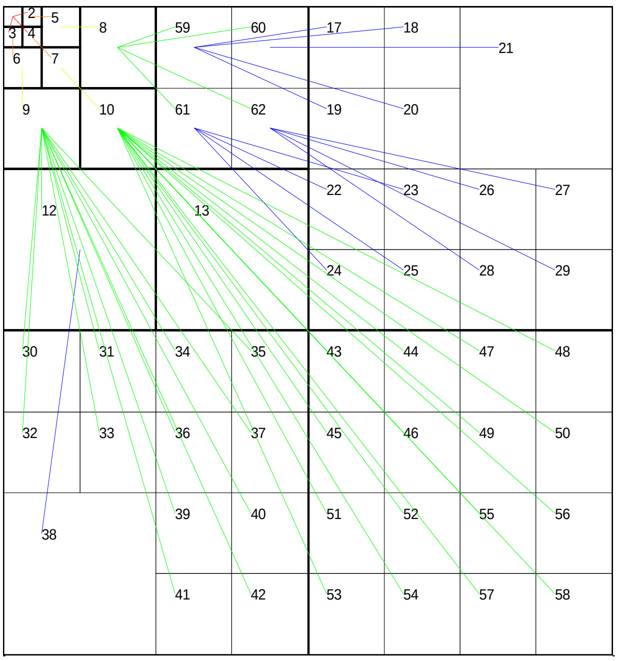
Graphical User Interface.



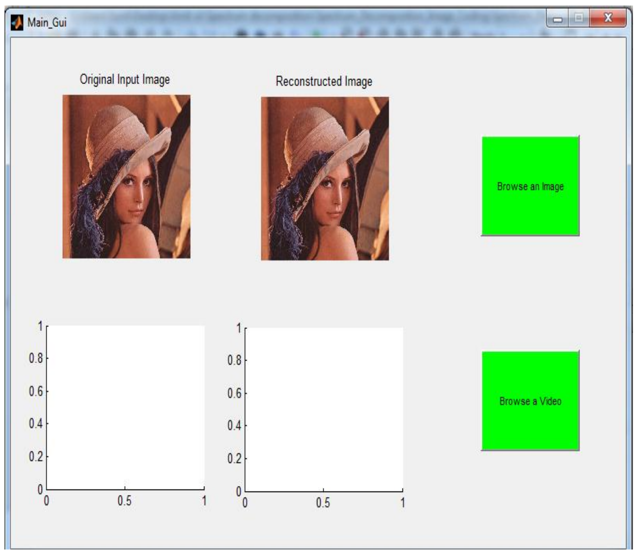
Wavelet packet structure drawn by 'S' subband



Wavelet packet transform coefficients



Wavelet packet structure drawn by 'S' subband



Final state of Graphical User Interface.

VIII. CONCLUSION

In this paper, we introduce a dual transform representation in which the signal spectrum is decomposed onto a set of orthogonal bases. The new spectrum decomposition (SCWP) is fundamentally different in several significant ways. The SCWP transform would show an excellent compaction performance with low computational complexity. It has significantly lower complexity than the CWP, and outperforms virtually all the other competing transforms in terms of quality and complexity. The SCWP could conceivably provide a useful representation for other image processing applications as well, such as de noising, enhancement, and digital forensics, and might be interesting to investigate in the future.

IX. REFERENCES

[1] J. Lin and M. J. T. Smith, “New perspectives and improvements on the symmetric extension filter bank for sub band/wavelet image compression, ”IEEE Trans. Image Process., vol. 17, no. 2, pp. 177–189, Feb. 2008.

[2] D. S Taubman and M. W. Marcellin, JPEG2000: Image Compression Fundamentals, Standards, and Practice. Boston, MA: Kluwer Academic, 2002.

[3] M. Antonini, M. Barlaud, P. Mathieu,and I. Daubechies “Image coding using wavelet transform,” IEEE Trans. Image Process., vol. 1,pp. 205–220, Apr. 1992.

[4]J. Lin and M. J. T. Smith, “Efficient block-based frequency domain wavelet transform implementations,” IEEE Trans. Image Process.,vol. 18, no. 8, pp. 1717– 1723, Aug.2009.

[5]J. Lin and M.J. T.Smith, “A two-channel overlapped block transform for image compression,” IEEE Trans. Image Process., vol. 19, no. 11, pp. 3064–3071, Nov. 2010 [6]H. S. Malvar, Signal Processing with Lapped Transforms. Norwood, MA: Artech House, 1992.

[7] R. L. de Queiroz, T.Q.Nguyen, and K. R. Rao, “The GenLOT: Generalized linear phase lapped orthogonal transform,” IEEE Trans. Signal Process., vol. 44, no. 3, pp. 497–507, Mar. 1996.

[8]T. D. Tran and T.Q.Nguyen, “A progressive transmission image coder using linear phase uniform filter banks as block transforms,” IEEE Trans. Image Process.,vol. 8, no. 11, pp. 1493–1507, Nov. 1999.

[9] W. K. Pratt, Digital Image Processing, 2nd ed. New York: Wiley, c1991.

[10]A. Said and W. S. A. Pearlman, “A new fast and efficient image codec based on set partitioning in hierarchical trees,” IEEE Trans. Circuits Syst. Video Technol. vol. 6, pp. 243–250, May 1996.

[11] “discrete cosine transform,” WIKIPEDIA, The Free Encyclopedia [Online]. Available: http://en.wikipedia.org/wiki/Discrete_cosine_ transform