Volume 4, No. 10, September-October 2013
ISSN No. 0976-5697
International Journal of Advanced Research in Computer Science
RESEARCH PAPER
Available Online at www.ijarcs.info

Adaptive Spectral Transform for KLT, Wavelet-Based Color Image Compression

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Abstract: Image compression is very important for efficient transmission and storage of images. But different regions of a color image generally exhibit different spectral characteristics. The energy compaction of implementing a single spectral transform to all parts is predominantly inefficient from a compression context. Thus, it is proposed that, before the resultant coefficients are coded by an efficient wavelet coefficient coding scheme such as "Color Set Partitioning in Hierarchical Trees" (CSPIHT), different subsets of wavelet coefficients of a color image be dealt with different spectral transforms. The spatial partitioning of the set of high frequency coefficients of the color planes into spatially oriented subsets, which can be further partitioned into smaller directionally oriented subsets represents a quadtree [1]. A compression system of asymmetric intricacy, that integrates the proposed adaptive Spectral transform with the CSPIHT coefficient coding scheme yields average coding gains over a compression system which integrates the single spectral transform is derived from the entire image with the CSPIHT coefficient coding scheme.

Keywords: Karhunen–Loeve transform, Adaptive coding, color, image coding, quad tree, wavelet transform.

I. INTRODUCTION

Image compression techniques especially nonreversible or lossy ones, have been accepted to thrive computationally more complex as they grow more efficient, confirming the precept of source coding theorems in information theory that a code for a source approaches optimality in the limit of infinite computation. A Single global spectral transform is applied to decorrelate the color planes of a color image prior to compression. The trivial method of independently coding each of the spectral lines with high performance wavelet-based gray scale image codecs such as set portioning in hierarchical trees (SPIHT), is highly inefficient since nonlinear dependencies at high transition regions do remain among the spectral planes. In recent years, wavelet based scalable image coding techniques have attracted increased interest due to their excellent rate contortion performance, low encoding and decoding intricacy, and rate scalability.

The wavelet transformed images have both inter- and intra- subband correlations among the coefficients. Most of the wavelet based techniques use either zero-tree to exploits these correlations [2]. The zero-tree coding algorithms for instance EZW and SPIHT, exploit intersubband correlations among the coefficients across the subbands only. The flimsy approach for coding of color images is to apply these algorithms independently on RGB color planes and then serially Concatenating the bit stream of each color plane. But, this requires proper bit allocation between each of the color planes and would not be fully embedded [6]. The SPIHT algorithms are prolonged to RGB color planes in and respectively to generate fully embedded bit streams. In these spiht algorithm, we have the list of insignificant pixels (LIP) and list of insignificant sets (LIS) are initialized with the appropriate coordinates of the top-level subband of the tree-color planes serially one after the other [3]. The CSPIHT algorithm, the three spectral planes of coefficients by defining the nodes in the lowest frequency subbands of the chrominance planes (second and third eigenvector component planes for Karhunen-Loeve transform (KLT)) as the children of the spatially corresponding nodes in the lowest frequency sub band of the luminance planes(principle eigenvectors component plane for KLT) [5]. Due to the structure of the overall tree, only luminance nodes and sets rooted at them are tested for significance at the initial passes.

II. ARCHITECTURE

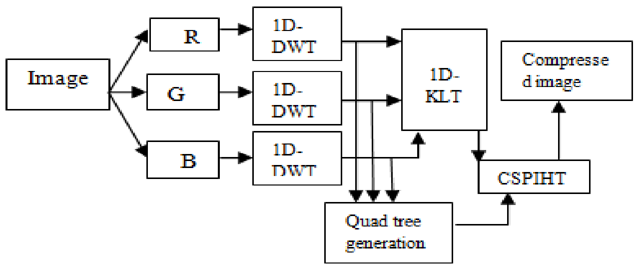


Figure 1: Proposed Model Architecture

In the above architecture, we first give a image and then converted in to R, G, B color models and second we apply one-dimensional DWT (discrete wavelet transform) for each color planes, third we do one-dimensional Karhunen-Loeve transform (1D-KLT) for reducing the unwanted pixels for each one dimensional wavelet transform, and fourth we do the quad tree generation for that 1D-DWT and finally we apply the CSPIHT for both quad tree and 1D-KLT pixel values then we get the compressed image.

A. ***Getting RGB values:*** convert the image into pixel values and then convert the pixel values into RGB planes.

B. ***Converting RGB values to the 1D-DWT:*** convert RGB planes to one dimensional discrete wavelet transform (1D-DWT) by using Haar transform, the Haar matrix of any dimension may be obtained by the following recurrence relation

$$H(n) = \begin{pmatrix} H(n-1) \otimes [1 \quad 1] \\ 2^{(n-1)/2} I(n-1) \otimes [1 \quad -1] \end{pmatrix}, H(0)=1$$

And $\bar{H}(n) \neq H(n)^T$ for n>1 and $\bar{H}(n)^{-1}=2^{-n}$. $H(n)^T$, where H(n)− matrix of the discrete Haar functions of degree 2^n, I(n)− identity matrix of degree 2^n, $\otimes$ the kronecker (tensor) product.

C. ***Converting 1D-DWT values to the 1D-KLT:*** choose the values of 1D-DWT and find the Eigen vectors to all the images for each wavelet values and store them.

D. ***Converting 1D-DWT values to the quad tree generation:*** divides a square image into four equal-sized square blocks, and the test each block to see if it meets some criterion of homogeneity [4]. If a block satisfies the criterion, its not divided any further. If it does not satisfy the criterion, it is split again into four blocks and the test criterion is applied to it. This process is iterated until each block meets the criterion. The results can have blocks of several different sizes.

E. ***Applying CSPIHT for quad tree generation and 1D-KLT****:* set partitioning in hierarchal trees is an image compression technique that exploits the inherent similarities across the sub band and finally we use for color images [3]. The algorithm of SPIHT is

Initialization:

K=⌊log2 (max |coeff|)⌋
LIP = All elements in **N**
LSP = Empty
LIS = **H**'s of Roots
Significance Map Encoding ("Sorting Pass")
Process LIP
for each coeff (i,j) in LIP
Output Sn(i,j)
If Sn(i,j)=1
Output sign of coeff(i,j): 0/1 = -/+
Move (i,j) to the LSP
Endif
End loop over LIP
Process LIS
for each set (i,j) in LIS
if type **H**
Send Sn(**H**(i,j))
If Sn(**H**(i,j))=1
for each (k,l)€**O**(i,j)
output Sn(k,l)
if Sn(k,l)=1, then add (k,l) to the LSP and output sign of coeff: 0/1 = -/+
if Sn(k,l)=0, then add (k,l) to the end of the LIP
endfor
endif
else (type **L**)
Send Sn(**L**(i,j))
If Sn(**L**(i,j))=1
add each (k,l) €**O**(i,j) to the end of the LIS as an entry of type **H**
remove (i,j) from the LIS
end if on type
End loop over LIS

Refinement Pass Process LSP

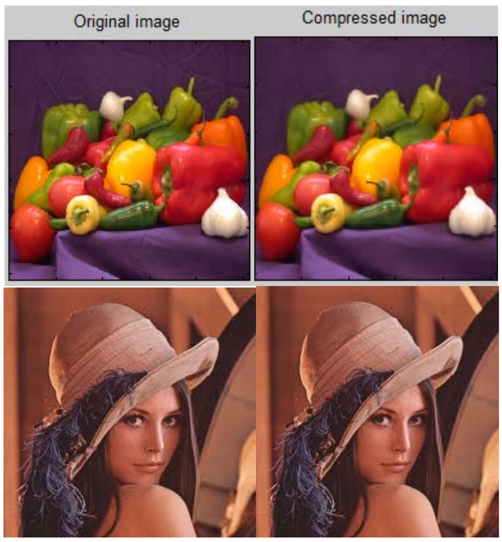
for each element (i,j) in LSP – *except* those just added above
Output the nth most significant bit of coeff
End loop over LSP
Update
Decrement n by 1
Go to Significance Map Encoding Step

III. RESULTS

Query image:

Figure: 2 Related images using RGB color models:

Figure: 3 Related results of using cspiht:



IV. CONCLUSION

In this paper, we proposed a multispectral image data and compressed the image. The objective of the work is to get the best compressed image, our experimental results indicates that the hierarchical application of the one-dimensional KLT transform for lowering the side information, and also employed quad tree-based partitioning of higher frequency coefficients into spatially, and finally we apply the CSPIHT for getting the compressed image.

V. REFERENCES

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Short Bio Data for the Authors

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