

ABSTRACT

In recent years most of the office work like written records, documents, images etc. are being replaced by digital data for storing, transmission and processing. Handling such digital form of images and data is much convenient than handling hardcopies of data. But the only challenge is that to store such a large size data, large disk space is needed. The way to overcome this challenge is to compress the data without losing important information and the originality. Excellent work has been done on image compression in previous few years. Results have proved that by using hybrid transforms better image compression can be achieved. Image compression with tiling also provide better results. This paper presents review on Image compression using tiling process with hybrid transform by using two different transforms.

KEYWORDS: Image Compression, DCT, DWT, HWT, Kekre Transform, Image Tiling.

INTRODUCTION

One of the major challenges in multimedia communication is to transmit the multimedia signals, especially the image and the video signals through limited bandwidth channels. It is possible to achieve compression through significant reduction of bit-rate requirements by exploiting the redundancies that is typically present in image. Uncompressed images can occupy a large amount of memory in RAM and in storage media, and they can take more time to transfer from one device to another.

Need of Image Compression

- Is needed to save the transmission bandwidth required.
- Is needed to save memory which is required to store the image.[7]
- Is needed for efficiently use the transmission time

Image compression has two main Components: Redundancy reduction and irrelevant data reduction. Redundancy reduction is achieved by removing extra bits or repeated bits. While in irrelevant reduction the smallest or less important information is omitted, which will not be received by the receiver. [7] Compression is done in the encoder and decompression is done in the decoder. Compression and decompression consists of following stages as shown in Fig. 1.

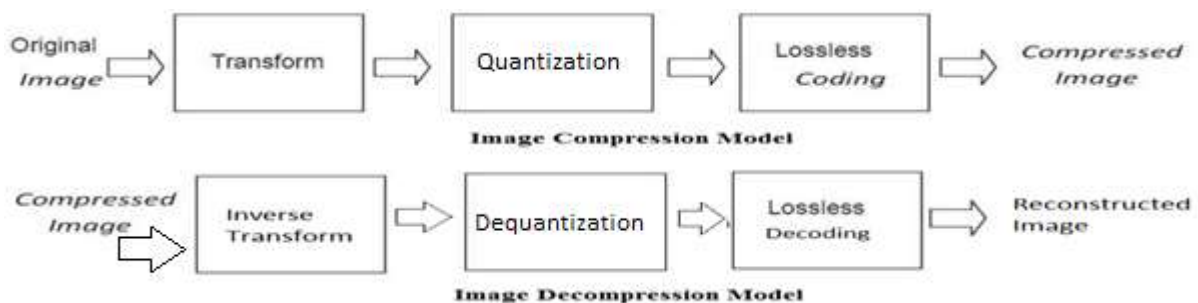


Fig. 1 Block diagram of image compression and decompression

There are two types of Image compression:

1. **Lossless compression:-** Lossless image compression schemes exploit redundancies without incurring any loss of data. Lossless image compression is therefore exactly reversible. Lossless image compression techniques first convert the images in to the image pixels. Then processing is done on each single pixel. Different Encoding Methods are Run Length, Huffman, Arithmetic , L-Z etc.
2. **Lossy compression:-** In this data after compression and decompression retrieves a file that is not exactly as the original data, as there will be loss of data. The image is first transformed into a string of symbols, which are quantized to a discrete set of allowable levels. If the loss in reconstruction quality is acceptable to our visual perception, then this can be used. Different methods used are Color space, Chroma sub-sampling, Transform coding, Fractal Compression.

TRANSFORM CODING

Transform coding techniques [11] use a reversible, linear mathematical transform to map the pixel values onto a set of coefficients, which are then quantized and encoded. Transform coding relies on the premise that pixels in an image exhibit a certain level of correlation with their neighboring pixels. Consequently, these correlations can be exploited to predict the value of a pixel from its respective neighbors. Different commonly used mathematical transforms, such as DCT, DWT, HWT, & Kekre Transform have been described as follows:

DCT (Discrete Cosine transform)

A discrete cosine transform (DCT) [11] expresses a sequence of finitely many data points in terms of a sum of cosine functions oscillating at different frequencies. DCTs are important to numerous applications in science and engineering, from lossy compression of images (where small high-frequency components can be discarded).

Although the DCT-based image compression algorithms such as JPEG have provided satisfactory quality, it still leaves much to be desired. Thus, the new DWT-based image compression algorithms such as JPEG 2000 became increasingly popular.

DWT (Discrete Wavelet transform)

A wavelet is waveform of limited duration that has an average value of zero. Wavelets are localized waves and they extend not from $-\infty$ to $+\infty$ but only for finite time duration. The basis of Discrete Cosine Transform (DCT) [11] is cosine functions while the basis of Discrete Wavelet Transform (DWT) is wavelet function that satisfies requirement of multi resolution analysis. DWT represents image on different resolution level i.e., it possesses the property of Multi-resolution. DWT converts an input image coefficients series x_0, x_1, x_m , into one high-pass wavelet coefficient series and one low-pass wavelet coefficient series (of length $n/2$ each).

HWT (Haar Wavelet Transform)

Haar wavelet compression is an efficient way to perform. The Haar wavelet is also the simplest possible wavelet. [3] Haar Transform is a very fast transform as its Computation speed is high. It is memory efficient, since it can be calculated in place without a temporary array. In Haar Transform the original signal is split into a low and a high frequency part and filters enabling the splitting without duplicating information are said to be orthogonal. [7]. Implementing the discrete Haar transform consists of acting on a matrix row-wise finding the sums and differences of consecutive elements. If the matrix is split in half from top to bottom the sums are stored in one side and the differences in the other. Next operation occurs column-wise, splitting the image in half from left to right, and storing the sums on one half and the differences in the other. The process is repeated on the smaller square.

[1] Previously only Haar wavelet transforms have been studied. But recently some of the orthogonal transforms like Walsh transform, Kekre Transform, DCT, Hartley Transform are proposed. The wavelet transforms give better performance are proved in many applications.

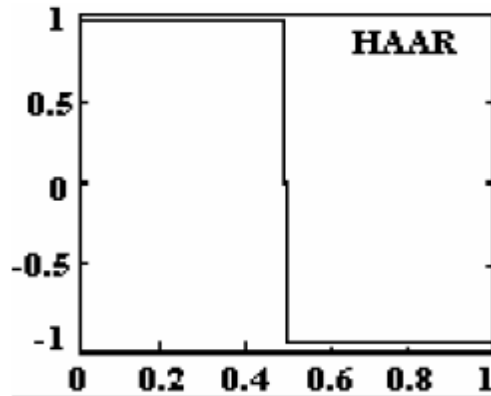
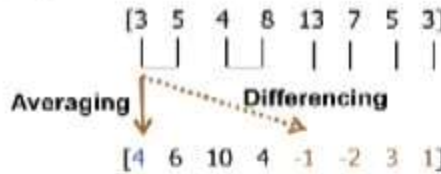


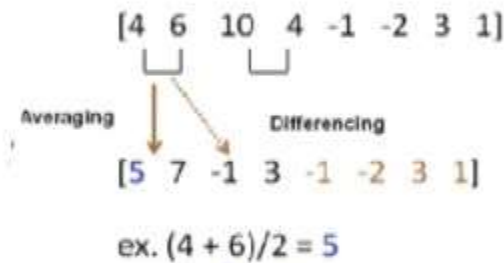
Fig. 2 : - Haar Wavelet

Steps for HWT are as follows:

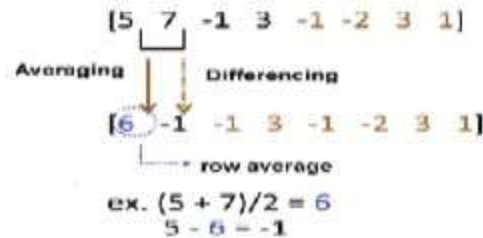
Step 1:



Step 2:



Step3:



The Hybrid wavelet transforms are generated by combination of two orthogonal transforms. [1]The concept of Hybrid transforms gives better performance than wavelet transforms.

Kekre Transform

Kekre Transform[10] matrix is the generic version of Kekre’s LUV color space matrix . Kekre Transform matrix can be of any size NxN, which need not have to be in powers of 2 (as is the case with most of other transforms). All upper diagonal and diagonal values of Kekre’s transform matrix are one, while the lower diagonal part except the values just below diagonal is zero. The formula for generating the term K_{xy} of Kekre Transform matrix is :

$$K_{xy} = \begin{cases} 1 \\ -N + (x + 1) \\ 0 \end{cases}$$

$$x \leq y$$

$$x = y+1$$

$$x > y+1$$

The basic concept of wavelet transform is to select appropriate wavelet function called mother wavelet and then perform an analysis using shifted and dilated versions of mother wavelet.[8]. Wavelet transform gives time frequency analysis of a signal. Initially in study of wavelets Haar wavelet transform was emphasized. In recent study wavelets of Walsh, Hartley, Kekre have been proposed and experimented. Experimental work has shown that wavelet transforms obtained from component orthogonal transform performs better in image compression. The Hybrid Transforms gives better performance than individual constituent transforms for image compression[1].

TILING IN IMAGE PROCESSING

Tile-based processing consists of dividing an image into small, rectangular pieces called "tiles," processing each tile, and reassembling the image [10]. The principle of locality applies, so an image-processing operation usually requires input tiles of approximately the same area as the output tile. Clearly, processing each tile requires less memory than processing the entire image.



Fig. 3: Figures showing 1 Tile , 4 Tiles, 16 Tiles respectively.

Image can be divided in 4 tiles, 16 tiles, etc. and transforms are applied on these tiles, feature sets can be obtained to be used in image retrieval[10]

CONCLUSION

In this paper different image compression transforms have been described along with tiling . There are various transformation techniques used for data compression. Discrete Cosine Transform (DCT), Discrete Wavelet Transform (DWT), Kekre Transform and HWT are the most commonly used transforms. All the image compression techniques are useful in their related areas and new compression techniques are developing by using hybrid transforms. Tiling combined with hybrid transforms like Kekre and DCT [1] have been proved to give better quality of compressed images. Further study can be extended using hybrid Kekre and HWT. Based on review of different types of compression techniques, we conclude that Tiling process used with Hybrid Transform can give better results for image compression.

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