

A Survey on Comparison between DCT and DWT Techniques of Image Compression

Pooja Rani¹, Apoorva Arora²

Chandigarh engineering college Landran (MOHALI).

Abstract: Image compression is a method that is used to reduce the irrelevance and redundancy of the image data i.e reduce the storage space for images, video in order to increase the performance of transmission process in an efficient form without compromising the quality and information of images. This paper deals with two image compression techniques. The first one is Discrete Cosine Transform (DCT) and the second one is Discrete Wavelet Transform (DWT). DWT and DCT both techniques of compression are based on frequency domain method of transformation, not on spatial domain method. In DCT method, the whole image is divided into $n*n$ blocks and then DCT is applied on these blocks while DWT method is used to hide information in the form of coefficients. At the end, compression is the solution for such kind of media (images, video) which are in large size. Both of these techniques are efficient for image compression.

Keywords: image Compression, DCT, DWT, wavelet compression, matrix decomposition

1. Introduction

As we know, digital media such as image, video, audio can be load or save on disk. The storage to save this digital media become a major issue in digital image processing. Therefore the concept of image compression required to solve this above issue. The main objective of image compression is to reduce the size of data i.e used to represent a digital media in an efficient manner without causing major degradation to the quality of the image. To increase the efficiency and performance of digital data, image compression is used in various fields like security industries, federal government agencies and health industries. The reduced size may facilitate the quick transfer of the data over the communication channels. There are two types of compression methods. One is lossy and second is lossless compression. In lossless compression, no information is lost that is reduces bits by finding and eliminating redundancy. Lossy compression technique reduces size of data by finding non essential information and destroys it. Therefore, the process of decreasing the size of data file is termed as data compression.

2. Overview of Techniques

Brief definition of most important compression techniques are given as follow:

A. DCT (Discrete Cosine Transform)

DCT is a frequency domain image transform method that is used to reduce the storage space where we want to store the image. In DCT, the whole image is divided into $n*n$ blocks then DCT is applied on these blocks. The changes across the width and height of the blocks are expressed as high order terms and the average value in a block is expressed as low order terms. The IDCT (Inverse discrete cosine transform) can be used to recreate the image from compressed representation. DCT is a lossy compression algorithm.

B. DWT (Discrete Wavelet Transform)

DWT also a frequency domain image transform method that is used to split the information of any digital media into approximation sub signal (used to show the pixel value) and detailed sub signal (used to show the vertical, horizontal and diagonal details). The main objective of DWT technique is to hide data in the form of coefficients. DWT is analyzed on filter bank. In digital image processing, two types of filters are used:-

1. HIGH PASS FILTER
2. LOW PASS FILTER

High pass filter is used to kept high frequency information while low pass filter is used to kept low frequency information.

For both of these techniques (DWT and DCT), the encoding system and decoding system of compression are necessary to transfer the original image into compressed image and vice versa. In encoding system original image take as input and compressed image take as output while In decoding system compressed image take as output and original image take as input.

3. Literature Review

Jasmeet kaur, ms. Pohini Sharma et.al (2012): This paper is written by author to present a combined DCT-DWT approach for video compression with scalability factor. The main purpose of this paper is to find how many redundancies in the video frame and how many scenes are correlated in a video for higher compression ratio.

Eman A.AL.Hillo, rusul zehwar et.al (2014): This is an article written by JACQUIN on fractal compression technique for examined the color image of size 24-bits/pixel. To take the benefit of existing spectral correlation and spatial resolution of human vision system, the data of color component are transformed to YIQ color space for more compression and the chromatic components (I,Q) was utilized to increase the compression ratio without making any significant distortion respectively. The result of this

research is that PSNR(31.05)db with CR(57.55) sec for lena image(256*256) pixel.

Anil kumar katharatiya, swati patel, Mahesh goyani et.al (2011): This paper is written by author to present a comparative analysis between DCT and DWT techniques of image compression. This paper compare DCT and DWT by using MSE (MEAN SQUARE ERROR) between original image and compressed image. This MSE value is represented on graph. In this writing, the author conclude that, DWT is better than DCT in quality wise while DCT is better than DWT in performance wise.

Sonja Grgic, Mislav Grgic et.al (2001): This is an article written by author to check how many wavelet functions are implemented in a existing image compression system to highlight the benefit of newly invented transform methods.

This paper purposed new features of wavelet transform in compression of existing image which are related to the degradation of quality of image by the process of wavelet compression and decompression. The quality of image is measured by using picture quality scale as peak signal-to-noise ratio (PSNR). The comparison between DWT and DCT are also discussed.

Harjeet singh, sakhi Sharma et.al (2012): This paper deals with DCT, DWT and Huffman encoding techniques to generate a hybrid compression algorithm which is used in many fields like telemedicine, wireless capsule endoscopies, x-ray, CT scan etc. The result of both DCT and DWT algorithm are compared by using MSE (MEAN SQUARE ERROR) and PSNR (PROBLISTIC SIGNAL TO NOICE RATIO) value.

Authors Year	Techniques Proposed	Problem Addressed	Our Review
Jasmeet Kaur et. al. [2012]	DCT-DWT based video compression	To achieve the higher compression ratio on the basis of video frame and scene evaluation.	The compression ratio is higher but it takes the higher execution time.
Eman A. AL. hillo et.al[2014]	Fractal compression technique for examined the size of color image.	Without any distortion in original image, image is transferred into YIQ color space and chromatic components to increase the compression ratio.	Color space components increase the compression ratio, but produced the data loss content.
Anil kumar et.al[2011]	Comparative analysis between DCT and DWT based on mean square value (MSE).	Finding which one is better DCT or DWT.	DCT and DWT has been proved better than all other surveyed.
Sonja grgic et.al[2001]	Wavelet functions and comparison between DCT and DWT.	Measured the quality of images by using picture quality scale as peak signal to noise ratio (PSNR).	PSNR proves the higher quality, but performance is lower than DWT and DCT.
Harjeet singh et.al[2012]	DCT, DWT, and Huffman coding	To generate a hybrid compression model which is used in many application.	Hybrid compression model is slower, but have higher time cost.

4. Compression Mechanisms

There are two compression mechanisms:-

- 1. Lossless compression:-**Lossless compression is a class of data compression that is used for reconstructing the original data from the compressed data. Lossless compression programs process in sequence. In this sequence, the first step is to produce a statistical model for input data and the second step is used to map the input data into bit sequences to create the shorter output. There are many encoding techniques that are used to generate bit sequence like arithmetic coding and Huffman coding. Both of these two techniques arithmetic coding technique of coding is better than Huffman coding because arithmetic coding achieve better compression rates for models that is best for statistical model. There are various application where lossless compression is used such as used in ZIP, PNG and GNU file format.
- 2. Lossy compression:** Lossy compression is a class of data compression that is used for reconstructing the approximation of the original data to improve the compression rates. There are various application where lossy compression is used such as TIFF and MNG. Lossy compression are mostly used for compressing digital media such as audio, video and images etc. lossy compression is better than lossless compression because lossy compression technique produce a smaller compressed file than lossless compression.

5. Conclusion

In this survey, we compare DCT (DISCRETE COSINE TRANSFORM) and DWT (DISCRETE WAVELET TRANSFORM) compression techniques. Both of these techniques are based on frequency domain method and both of these have its own advantages and disadvantages. In DCT technique information is divided into n*n blocks while DWT technique is based on approximation and detailed sub signal. Both techniques are efficient for quality wise while DCT is better than DWT in performance wise.

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