# A Study on Wavelet Based Approaches for Information Embedding

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***Abstract*— A remarkable growth is seen in the use of digital image now a day's including various applications which are involved in our day to day life like image-on-demand, digital television, image-conferencing, advertising, surveillance, entertainment and distance learning. Many user experience digital image when they watch a motion picture recorded on a digital video disc (DVD) or downloaded over the internet. The digital image's proliferation are encouraged into many more applications by improving the compression technology which results into better authoring and editing tools as well as more available bandwidth in digital communication networks and lower cost capture and display devices. This article discuss a detailed survey on the watermarking of gray level images over colored image.**

***Keywords—wavelet, haar, daubechies, sine transfrom, component analysis***

## I. INTRODUCTION

The copying, manipulation and the distribution of digital multimedia ( graphics, audio and photo) through networks turns into rapid and less complicated. As the vendors and creators of the digital merchandise are mindful of unlawful copying of their merchandise. For this reason, protection copyright protections are primary topics referring to multimedia purposes and services[1].

Prior, the watermarking strategies had been proposed for these aforesaid functions, in which the copyright knowledge is embedded into multimedia data for shielding the possession. Therefore, study is now being concerned with watermarking schemes to shield multimedia expertise. The most suitable science that may serve this motive, is none as opposed to digital watermarking. Multifarious watermarking schemes were proposed to camouflage copyright marks and different information in digital pictures, audio, photo and other multimedia objects[2].

One of the largest technological events of the last twenty years was the aggression of digital media within the entire vary of daily routine aspects. Computer techniques can easily manipulate and store the digital data efficiently and effectively that too with a high quality. Furthermore, digital knowledge can be transmitted in a speedy and low-priced approach by means of knowledge conversation networks without losing signal-rate[5]. A watermarking is adding "ownership" knowledge in multimedia contents to prove the authenticity along with embedding a data which is an unperceivable digital code, particularly the watermark that contains expertise in regards to the copyright fame of the work to be included.

Although, endless efforts are taken to design an effective and efficient watermarking technique but approach recommended so far does not look to be robust for all predetermined attacks and interactive media data handling process. The rough and snappy increase in watermarking interest is likewise because of the rise in matter over intellectual property rights. Generally, the watermarking of still images, audio and image demonstrate certain common fundamental concepts. Innumerable watermarking applications reported in the literature depend upon the services we wish to apply. Thus, watermarking techniques may be relevant in numerous areas which may include copy protection, copyright protection, fingerprinting, and temper detection etc. [1][3].

## II. DISCRETE WAVELET TRANSFORM

Discrete Wavelet Transform (DWT) is the discontinuous variant of signal transform. The Discrete wavelet transform serves as an authentic opportunity to the cosine transform that is pre-owned by standard JPEG image extensions[7]. Basically, it is based on the hierarchy structure having N levels that can be processed by choosing a proper filter bank. Substantially it is feasible to go through two approaches that contrast with each other just only due to the benchmark required to extricate series of image samples to be exaggerated by the filter banks[9]. Most image watermarking techniques are based either in the Discrete Wavelet Transform (DWT) or the Discrete Cosine Transform (DCT) domain[11]. Very few watermarking procedures are based on more different transforms like the fractal transform and the Fourier-Mellin Transform. The discrete wavelet transform domain is more better alternate for image watermarking as compared to other algorithms[10]:

1. The DWT provides interesting spatial and frequency localization of pertinent image attributes like textures and edges. In special, the excessive frequency content material of the picture corresponds to gigantic coefficient in the element sub bands. Consequently, watermark encoders operating in the discrete wavelet environment can without difficulty, points out the excessive-frequency attribute of an snapshot and insert maximum of the watermark strength in that phase[8]. Such insertion procedure will validate in intrinsic visual masking of the

watermark since the visual system has a very less capability to find out high frequency marks.

2. The discrete wavelet transforms multi-resolution representation of images facilitates progressive transmission of image content and tree structure decrypting of encapsulated watermarks[4].
3. Essentially, the discrete wavelet transform stipulates great form of the human visual system. The two frequency disintegration of the discrete wavelet transform features like the pyramid disintegration of the hypothetical Cortex Transform [1,2] which forms the HVS. As a consequence, the discrete wavelet transform permits the disparate non-cognitive bands of the human visual system to be delighted separately[6].
4. The discrete wavelet transform is optimally competent. This transform can be optimally obtained in continuous straight way.
5. The DWT is flexile as there are infinite wavelet filter banks. The multitude of appropriate filters and filter bank arrangements provides eminently personalized dealing with individual image content. The resilience in the top of wavelet filters may also be oppressed to raise the warranty of the watermarking tactics performing within the wavelet area. In numerical and operative methods, a discrete wavelet change into is validated method[5].

## III. Wavelet Functions

Some examples of discrete wavelet transform are as follows:

### A. *Haar Wavelets*

The first discrete wavelet transform was simulated by the Hungarian mathematician named Alfréd Haar. For input represented by a function, pairing, rotate repeated scale: finally resulting in 2n-1 differences and one final sum[7].

### B. *Daubechies Wavelets*

The uttermost frequently usage of specific set of discrete wavelet transforms was designed by the Belgian mathematician Ingrid Daubechies in 1988. The construction is established on the usage of repeated relations to engender gradually refined discontinuous quantifying of an absolute main wavelet function; every resoluteness is two times of the last scales. In his seminal paper, Daubechies discusses the wavelet families, wherein the first defined is the wavelet defeat. Interest in this field has after the explosion, and Daubechies' original forms led to developments of wavelets[7].

### C. *Dual Tree Complex-Wavelet:*

It's invariant and directionally selective in two and excessive amplitude. It achieves this with redundancy component of most effective 2^d for un-decimated. It's greatly astonish than the d-dimensional signals, DWT. The multidimensional (M-D) dual-tree CWT is non-separable but is centered on a computationally separable filter banks[20].

### D. *Others*

Other varieties of discrete wavelet transform involves the bearable wavelet transform(where down sampling is removed) and the Newland transformation where an ordinary wavelets is obtained from suitably formulated top-hat filters.

## IV. Information Embedding Using Wavelets

Wavelet transformation is a time domain localized synthesis process with the fixed window's size and schemes convertible. There is a significant high time extricated degree in high frequency regions of image. Also there is match able better frequency extricated degree in its low frequency region. This can filter the information from image significantly. The concept of discrete wavelet transform in image processing is to multi-extricated disintegration of the image into sub- images of various spatial domain and beyond control frequency domain[5][6]. Then coefficient index is transformed for sub-image.

When the common duvet image has been wavelet changed, it is fragmented into four frequency districts, that is to say three high-frequency districts(LH,HL,HH) and one low-frequency district(LL)[6]. The sub-level frequency band understanding may also be got, with the aid of reworking the information of low frequency district through discrete wavelet transform.

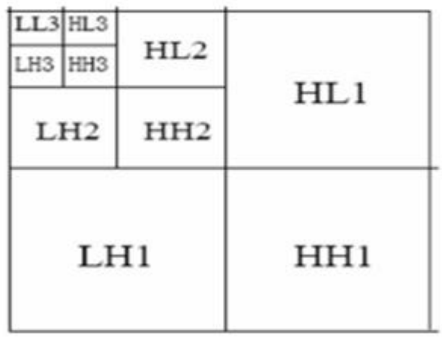


Figure 1: Sketch Map Of Image DWT Decomposed

A 2D image after disintegration of three time scan be shown as Fig.1, where low-pass filter is represented by L and H represents high-pass filter. A decomposed original image can be obtained of frequency districts of HL1, LH1, and HH1. sub-level frequency domain information content of LL2, HL2, LH2 and HH2 can also be obtained by decomposition by low-frequency district information. And thus *n* level of original images can be obtained by wavelet transformation.

The fact that the low frequency district obtained is an image similar to the original image. Maximum information content of original cover image is stored in this frequency domain. Frequency LH, HL and the district HH respectively represents the detail level, detail and diagonal detail honest of the original image. The HVS, according to the human character eyes are sensitive to changes district of smooth image, but not sensitive to the tiny torrent, profiles and changes beam. Therefore, it's tough to know that inserting the watermarking image content into the great extent coefficient index of high-frequency district of the image which discrete wavelet transform changed. Then it can carry more good hiding watermarking signal and effect.

Usually embedding is carried out in any of these bands using a secret key. Major contribution carried in literature are as follows:-

Dejiy and Rajesh proposed[7] 'Robust Color Image Watermarking Schemes in the Wavelet Domain' [33]. Two approaches are discussed in which one utilizes the chrominance content of image after performing single discrete wavelet transform decomposition for watermarking and later use both luminance and chrominance. To increase robustness, watermark is scrambled before embedding and does not get affected on the various attacks performed and without any distortion.

'A Novel Binary Image Digital Watermarking Algorithm Based on DWT and Chaotic Encryption'[8] is based upon discrete wavelet transform where a sequence of logistic chaotic is used and for scrambling the watermark generalized cat mapping is chosen [34] for enhancing security. The watermark is embedded in the low frequency co-efficient of the domain and use key and if it's not known to the attacker then the attack is failed.

One more approach 'A Novel Image Zero Watermarking Scheme Based on DWT-SVD' by Zhou, Jin[3] has been taken into account which inevitably leads to some quality degradation to embed a watermark [35]. Original image is decomposed using discrete wavelet transform and each block is applied with singular value decomposition to get singular value which is realized through XOR operation between first singular value of each block and actual pixel value sequentially.

A technique based on discrete fourier transform and feature extraction is discussed in 'Robust Digital Image Watermarking Method Based on Discrete Fourier Transform' by N. Terziya [9]. The aim of this paper is to resist geometric distortion and signal processing attacks performed in spatial domain and the author has also discussed about the 'Digital Image Watermarking in Wavelet Domain' where the two algorithms are proposed.

## V. CONCLUSION

Wavelet transform is used to define the frequency and time scale based decomposition of a given signal. In image processing its utility signifier in terms of multi resolution analysis and breaking down ofa image in various mid frequency components. Any given information can be embedded into any of these freq bands using a list of major schemes as suggested in previous section. Thus this article can prove as a milestone gathering of various basic details of wavelet transform and its application for information embedding.

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