WAVELET TRANSFORMATION OVER FOURIER TRANSFORMATION

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ABSTRACT

Signal can be expressed as a sum of a possible infinite, series of sines and cosines and this sum is called Fourier transform. In Fourier transform we go for only frequency resolution but no time resolution. Thus for shortcoming the problems of Fourier transform we use wavelet transform .In wavelet analysis the use of fully scalable modulated window solves the signal cutting problem. We talked about time scale representation. In this paper we analysis the usage of wavelet over Fourier.

Keywords: Wavelet, DWT & DFT

I. INTRODUCTION

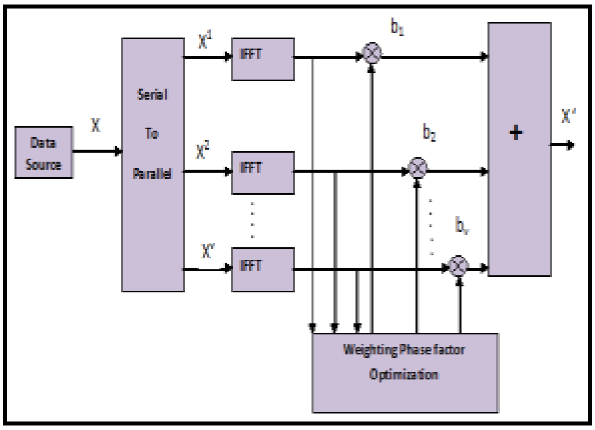
In mathematics, a wavelet series is a representation of a square-integrable (real- or complex-valued) function by a certain orthonormal series generated by a wavelet. Wavelet transformation is one of the most popular candidates of the time-frequency-transformations. Provides a formal, mathematical definition of an orthonormal wavelet and of the integral wavelet transform.[9]

II. FOURIER TRANSFORM

The motivation for the Fourier transform comes from the study of Fourier series. In the study of Fourier series, complicated but periodic functions are written as the sum of simple waves mathematically represented by sines and cosines. The Fourier transform is an extension of the Fourier series that results when the period of the represented function is lengthened and allowed to approach infinity.[3]

$$f(x) = a_0 + \sum_{n=1}^{\infty} \left(a_n \cos\frac{n\pi x}{L} + b_n \sin\frac{n\pi x}{L} \right)$$

Due to the properties of sine and cosine, it is possible to recover the amplitude of each wave in a Fourier series using an integral. In many cases it is desirable to use Euler's formula, which states that $e^{2\pi i\theta} = \cos(2\pi\theta) + i\sin(2\pi\theta)$, to write Fourier series in terms of the basic waves $e^{2\pi i\theta}$. This has the advantage of simplifying many of the formulas involved, and provides a formulation for Fourier series that more closely resembles the definition followed in this article. Re-writing sines and cosines as complex exponentials makes it necessary for the Fourier coefficients to be complex valued. The usual interpretation of this complex number is that it gives both the amplitude (or size) of the wave present in the function and the phase (or the initial angle) of the wave. These complex exponentials sometimes contain negative "frequencies". If θ is measured in seconds, then the waves $e^{2\pi i\theta}$ and $e^{-2\pi i\theta}$ both complete one cycle per second, but they represent different frequencies in the Fourier transform. Hence, frequency no longer measures the number of cycles per unit time, but is still closely related.[4]



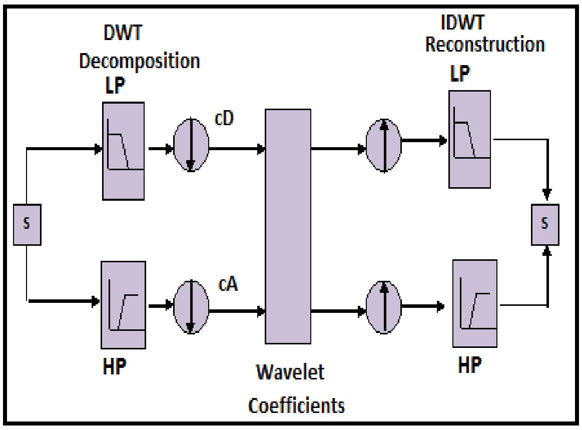


Figure 1 **Figure 2**

III. WAVELET TRANSFORM

The fundamental idea of wavelet transforms is that the transformation should allow only changes in time extension, but not shape. This is effected by choosing suitable basis functions that allow for this.[how?] Changes in the time extension are expected to conform to the corresponding analysis frequency of the basis function. Based on the uncertainty principle of signal processing,[2]

$$\Delta t \Delta \omega \geqq \frac{1}{2}$$

where t represents time and ω angular frequency (ω = 2πf, where f is frequency). The higher the required resolution in time, the lower the resolution in frequency has to be. The larger the extension of the analysis windows is chosen, the larger is the value of Δt.[5]

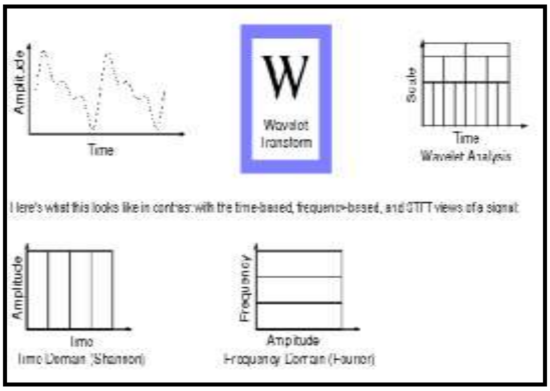


Figure 3

IV. WAVELET AND FOURIER

Transformation	Representation	Output
Fourier transform	$f(\xi) = \int_{-\infty}^{\infty} f(x) e^{-2\pi i x \xi} dx$	ξ, frequency
Time-frequency analysis	$X(t, f)$	t, time; f, frequency
Wavelet transform	$X(a, b) = \frac{1}{\sqrt{a}} \int_{-\infty}^{\infty} \overline{\Psi\left(\frac{t-b}{a}\right)} x(t)\, dt$	a, scaling; b, time

Table-1

Wavelet transform is similar to Fourier Transform both are flexible and informative. It is a tool which break data in to different frequency components and sub bands and then studies each component with resolution that its scale.[3]

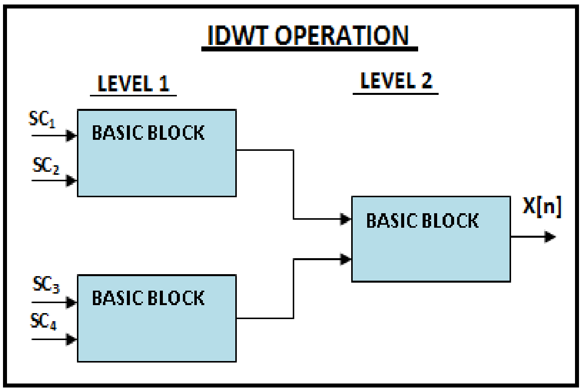


Figure -5

In fourier transform domain, we completely lose information about the localization of the features of an audio signal. Wavelet expansion allows a more accurate local description and separation of signal characteristics.[8].
The fourier basis functions have infinite support in that s single point in the fourier domain contains information from every where in the signal. Wavelets expansion have compact or finite support and this enables different parts of a signal to be represented a component that is itself local and is easier to interpret.[6]
Wavelet are adjustable and adaptable and therefore used for adaptive system purpose. While fourier transform is used for only the signal consists of a few stationary components.
Wavelet is very much comfortable for signal and audio compression.[10]

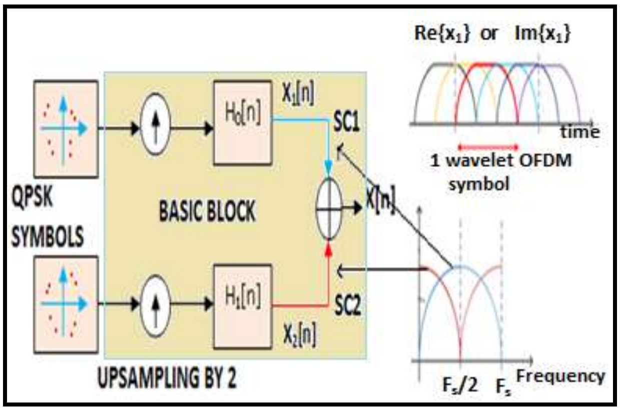


Figure -6

Wavelet based orthogonal Frequency Division multiplexing system (WT-OFDM) is a promising alternative to Fast Fourier Transform based Orthogonal Frequency Division Multiplexing (FFT-OFDM). A key advantage in WTOFDM system is the better resistance to the inter-symbol interference (ISI) and the inter-carrier interference (ICI) [2]. Therefore, it is widely concerned. In WTOFDM, the Orthogonality of the different sub-carrier is maintained by the basic function known as wavelets instead of sinusoids used in the FFT-OFDM.

V. CONCLUSION

In this paper we have discussed the importance of wavelet transform over the fourier transform. Regarding to so many communication fields we can analyse more accurate results by the use of wavelet Transform. As now days wavelets transform shows more accuracy for signal and image processing. Regarding communication system we use Wavelet transform for more efficient results.

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