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CHANNEL ANALYSIS OF OFDM SYSTEMS USING DWT AND DFT

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Abstract-Multiple Input Multiple Output (MIMO) and Orthogonal Frequency Division Multiplexing (OFDM) are the two assuring technologies that offer high data rate as required for the 4G wireless system. We propose a novel DFT and DWT based channel estimation technique in OFDM-MIMO system. The conventional DFT-based estimator zeroes out noise-dominant values in the transformed domain, it suffers from a poor performance when channel leakage is presence. Some improved estimators have been used, but all these estimators focus on reducing the leaked energy. In order to estimate the channel leakage Partial minimum mean square error (P-MMSE) filtering is used. The well-known performance criteria: Mean Square Error (MSE), Bit Error Rate (BER) and Signal to Noise Ratio (SNR) are used for comparison using 16-QAM modulation technique.

Keywords- Multiple Input Multiple Output, Orthogonal Frequency Division Multiplexing, Discrete Fourier Transform, Discrete Wavelet Transform.

I. INTRODUCTION

A major drawback in most wireless systems is that the presence of a multipath channel. In multipath surroundings, the transmitted signal reflects off of several objects. Because of thismultiple delayed versions of the transmitted signal attain the receiver. Several wired systems even have an identical drawback wherever reflections occur thanks to electrical phenomenon mismatches within the conductor. A multipath channel can cause 2 issues for associate OFDM system. the primary drawback is intersymbol interference.

This drawback happens once the received OFDM image is distorted by the antecedently transmitted OFDM image. The result is analogous to the intersymbol interference that happens in a very single- carrier system. OFDM image amount is way longer than the time span of the channel. The second drawback is exclusive to multicarrier systems and is termed Intrasymbol Interference. it\'s the results of interference amongst a given OFDM symbol's own subcarriers. following sections illustrate however OFDM deals with these 2 sorts of interference.

- Inter symbol interference
- Intra-symbol interference

Inter Symbol interference: Assume that the time span of the channel is LC samples long. rather than one carrier with an information rate of R symbols/ second, associate OFDM system has N subcarriers, every with an information rate ofR/N symbols/second. as a result of the info rate is reduced by an element of N, the OFDM image amount is accumulated by an element of N. By selecting associate applicable worth for N, the length of the OFDM image becomes longer than the time span of the channel.

Because of this configuration, the result of intersymbol interference is that the distortion of the primary LC samples of the received OFDM image.By noting that solely the primary few samples of the image ar distorted, one will contemplate the employment of a guard interval to get rid of the result of intersymbol interference. The guard interval may be an area of all zero samples transmitted before of every OFDM image.Since it doesn't contain any helpful info, the guard interval would be discarded at

the receiver. If the length of the guard interval is correctly chosen such it's longer than the time span of the channel, the OFDM image itself won\'t be distorted.

Intrasymbol interference: The guard interval isn't utilized in sensible systems as a result of it doesn't stop associate OFDM image from intrusive with itself. this sort of interferencem is termed intrasymbol interference. This property is true in discrete-time on condition that the signals ar of infinite length or if a minimum of one in every of the signals is periodic over the vary of the convolution. it's not sensible to own associate infinite-length OFDM image, however, it\'s doable to form the OFDM image seem periodic.

This periodic type is achieved by exchange the guard interval with one thing referred to as a cyclic prefix of length record samples. The cyclic prefix could be a reproduction of the last record samples of the

OFDM image wherever record > LC. Since it contains redundant info, the cyclic prefix is discarded at the receiver. just like the case of the guard interval, this step removes the results of entomb image interference. as a result of the means within which the cyclic prefix was fashioned, the cyclically-extended OFDM image currently seems periodic once convolved with the channel.

An important result's that the result of the channel becomes increasing. in a very digital communications system, the symbols that attain the receiver are convolved with the timedomain channel impulse response of length LC samples. Thus, the result of the channel is convolution. So as to undo the results of the channel, associateother convolution should be performed at the receiver employing a timedomain filter referred to as an equalizer. The length of the equalizer must air the order of the time span of the channel. The equalizer processes symbols so as to adapt its response in an endeavor to get rid of the results of the channel. Such associate equalizer may be overpriced to implement in hardware and infrequently needs an oversized variety of symbols so as to adapt its response to an honest setting.

II. DFT BASED OFDM CHANNEL

An idea was proposed within the mid1960's to handle this wastefulness through the event of frequency division multiplexing (FDM) with overlapping sub-channels. The sub-channels were organized so the sidebands of the individual carriers overlap while not inflicting ICI. This principle is shown in Fig 1(B). to attain this, the carriers should be mathematically orthogonal. From this constraint the thought of OFDM was born. OFDM could be a combination of modulation and multiplexing. Multiplexing typically refers to freelance signals, those created by totally different sources. In OFDM the signal itself is initial split into freelance channels, modulated by knowledge and so re-multiplexed to make the OFDM carrier. OFDM could be a special case of FDM.

$$X(k) = \sum_{n=0}^{N-1} x(n) e^{\frac{-j\,2\pi k}{N}}$$

X(k)represents the DFT frequency output at the k-the spectral purpose wherever k ranges from zero to (N-1). the number N represents the amount of sample points within the DFT knowledge frame. the number x(n) represents the ordinal time sample, wherever n additionally ranges from zero to N-1. generally equation, x(n) is real or advanced. The input is classified into odd and even variety.

The X(0) till X(31) variables ar denoted because the input values for FFT computation and Y(0) till Y(31) ar denoted because the outputs. There ar 2 operations to finish the computation in every stage. The upward arrow can execute addition operation whereas downward arrow can execute subtraction operation. The subtracted worth is increased with twiddle issue worth before being processed into subsequent stage. This operation is completed at the same time and is understood as butterfly method.

III. WAVELET BASED OFDM CHANNEL

Orthogonal Frequency Division Multiplexing (OFDM) may be a special variety of multi carrier transmission that has found its application in an exceedingly variety of wireless and wired systems. In OFDM, an oversized variety of orthogonal, overlapping, slim band sub-channels or subcarriers, transmitted in parallel, divide the obtainable transmission information measure. The separation of the subcarriers is on paper borderline specified there\'s a really compact spectral utilization. This paper presents the summary then the performance analysis results of AN OFDM system by victimization quick Fourier rework (FFT) and distinct ripple rework (DWT).The different techniques are HAAR, DAUBENCHIES, BIORTHOGONAL Transforms. The results bestowed within the paper area unit supported laptop simulations performed victimizationMatlab; a extremely economical tool for various applications

A wavelet based OFDM system with beam former and MIMO configuration is explained during this section. The transmitter and receiver half respectively with K=8 variety of sub-carriers as an example. we have a tendency to contemplate this method is in a very multiuser atmosphere of K busybodied users, wherever Kth user embellished with variety of antennas is human activity with a base station equipped with N variety of antennas.

On the transmitter aspect, 1st a binary section shift keying (BSPK) modulator is employed for mapping S(k) knowledge stream to the image stream x(n) . when the mapping method a parallel- to-parallel (P/P) device reshapes the modulated knowledge stream into, as an example, N = eight parallel knowledge streams. This P/P device makes positive that wherever n is associate number, in order that the transmitter will perform inverse distinct wavelet rework (IDWT) and turn out one final sequence little by little. ordered 2 image streams area unit up-sampled by the up-sampling issue two, filtered by the wave filter or , severally, and so summed. Output streams area unit up-sampled by two, filtered and summed once more. The up-sampling and filtering processes continue till one single output stream is obtained. in keeping with QMF, the connection between each filters is given by , wherever L is that the filter length of the impulse response g (n). when getting the output stream (or wave coefficients), is increased by Beamforming vector and weighted signals area unit adscititious to make the signal.

Orthogonal frequency division multiplexing (OFDM) has recently become a key modulation technique for each broadband wireless and wire-line applications. it\'s been adopted for digital audio broadcasting (DAB) and digital terrestrial tv broadcasting (DVB). OFDM could be a special case of Multicarrier transmission, wherever one knowledge stream is transmitted over variety of lower rate Subcarrier. the matter of intersymbol interference (ISI) introduced by multipath channel is considerably reduced in OFDM by mistreatment the cyclic prefix (CP) as a guard interval between OFDM blocks.

The projected work would be a quick summary of IFFT & FFT rule to be effectively employed in OFDM system.OFDM could be a special case of multicarrier transmission, wherever one knowledge stream is transmitted over variety of lower rate subcarriers. the most reason to use OFDM is to extend the strength against the selective attenuation or narrowband interference. The overall signal information measure, in a very classical parallel information system, will be divided into N non-overlapping frequency sub-channels. every sub-channel is modulated a separate image and so N sub-channels area unit frequency multiplexed. the final apply of avoiding spectral overlap of sub-channels was applied to eliminate inter-carrier interference (ICI). This resulted in depleted utilization of the prevailing spectrum.

An idea was projected within the mid1960’s to trot out this wastefulness through the event of frequency division multiplexing (FDM) with overlapping sub-channels. The sub-channels were organized in order that the sidebands of the individual carriers overlap while not inflicting ICI. This principle is shown in Fig 1(B). to attain this, the carriers should be mathematically orthogonal. From this constraint the thought of OFDM was born. OFDM could be a combination of modulation and

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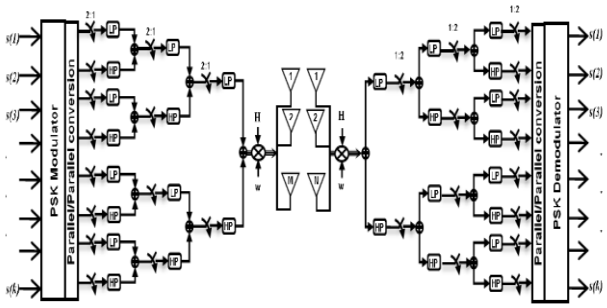

Figure 1 Wavelet based Multiuser OFDM with MIMO

QAM Modulation and demodulation:
Quadrature amplitude modulation (QAM) is eachan analogy and a digital modulation theme. It conveys two analogy message signals, or two digital bit streams, by changing (modulating) the amplitudes of two carrier waves, using the amplitude-shift keying (ASK) digital modulation theme or AM (AM) analogy modulation theme. the two carrier waves, typically sinusoids, area unit out of part with one another by 90° and area unitthereforeknown asconstruction carriers or constructionelements — thence the name of the theme. The modulated waves area unit summed, and therefore theensuingundulationcould be a combination of each phase-shift keying (PSK) and amplitude-shift keying (ASK), or (in the analogy case) of modulation (PM) and AM. within the digital QAM case, a finite variety of a minimum of2 phases and a minimum oftwo amplitudes area unit used. PSK modulators aretypically designed exploitation the QAM principle, howeveraren'tthought of as QAM since the amplitude of the modulated carrier signal is constant. QAM is employed extensively as a modulation theme for digital telecommunication systems. willy-nilly high spectral efficiencies is achieved with QAM by setting an acceptable constellation size, restrictedsolely by the background level and one-dimensionality of the communications channel.

IV. SIMULATION RESULTS

In figure 2 simulation result is shown. In that different channel estimation techniques are compared.

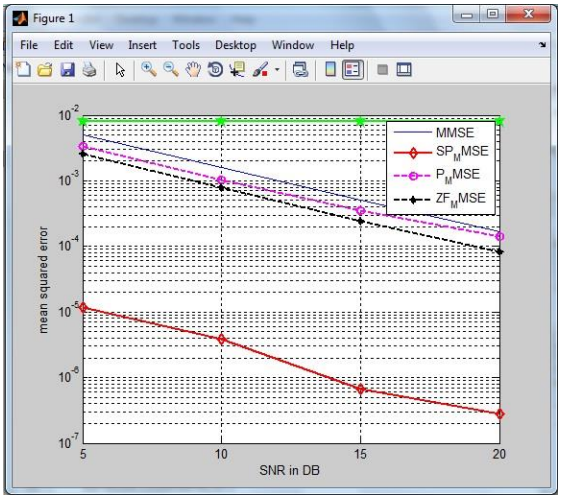

Figure 2 DFT based Channel Estimation analysis

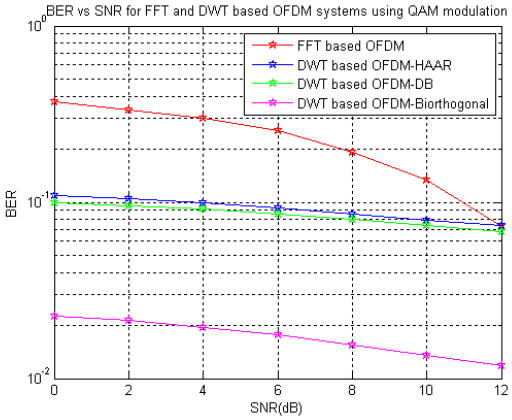

Figure 3 DWT based Channel Estimation analysis

V. CONCLUSION

BER performance of the FFT based OFDM systems can be found over AWGN and Rayleigh fading channel using different modulation schemes like BPSK, QPSK, QAM and Channel Equalizing on LS, LMMSE Process.From the plots of the BER as a function of the Signal to Noise Ratio (SNR), it can be concluded that when the Signal to Noise Ratio (SNR) is very low and does not have any impact on the BER but if Signal to Noise Ratio (SNR) increased the BER is reduced.

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