

A NEW APPROACH TO PERFORMANCE ANALYSIS OF DISCRETE WAVELET BASED MULTIUSER MIMO-OFDM FOR BPSK MODULATION SCHEME

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Abstract: This paper examines the enactment of ripple (otherwise referred to as wavelet) situated MU-MIMO OFDM systems and in addition evaluate with the performance of FFT based MIMO OFDM. Wavelet situated OFDM has lot of advantages compare to the FFT situated OFDM, where there is no need for cyclic prefix, flexibility and optimum decision. Wavelets were existed suitably in almost all the arenas of Wi-Fi verbal exchange schemes with OFDM which is a long lasting applicant for next peers of Wi-Fi scheme. That's 0.33 new release of partnerships mission (3GPP) networks. Simulation created examination will be jumble sale to simulate the double multicarrier schemes. DWT with HAAR mother built multicarrier additionally the predictable OFDM, less than the outcome of white Gaussian noise channel (AWGN). Established on the bit error price presentation to the transmission ability, the DWT built multicarrier scheme was established to be higher to the predictable OFDM scheme taking more than one antennas scheme, by means of BPSK also QPSK as dual modulation schemes in additive white Gaussian noise channel (AWGN).

Keywords: MIMO-OFDM, FFT, DWT, AWGN, Modulation schemes

1. INTRODUCTION

An Orthogonal Frequency Division Multiplexing (OFDM) scheme remains a multicarrier modulation as good as multiplexing scheme which employs an identical processing system letting the synchronized broadcast of information arranged a few fully unfold out, orthogonal sub-carriers. The distortion is the greatest enemy of all varieties of communication methods which is caused by using the multi route

fading channel. Multi direction fading occurs in both arenas i.e., time and frequency. The multi course fading greatly diminishes the performance of an OFDM System. OFDM has very special speed knowledge premiums, these knowledge premiums are spitted into quantity of subcarriers. The OFDM has lot of advantages, spectral efficiency could be very high, diminishing the impulse noise over the channel, robustness against co-channel interference and inter image interference. The loss of affectivity is caused by way of cyclic prefix or protect interval. The FFT headquartered traditional OFDM system is used to multiplex the alerts together and in addition decode the data symbol via the receiver respectively. The cyclic prefix is delivered before the transmitting sign, to stay clear of the inter-symbol interference (ISI) in addition to inter-channel interference (ICI). The cyclic prefix is nothing but periodic extension that is to increase the lengthen spread. But, the CP decrease the spectral suppression of the channels. Ripple transforms are used as the replacement systems for changing the FFT headquartered OFDM method. Discrete wavelet is quite often used in the OFDM process. It has Low Pass Filter (LPF) plus excessive go Filter (HPF) realistic as a Quadrature reflect Filters procedure in additionally fulfilling best renovation as well as orthonormal bases houses. That is also known as sub-band coding therefore these signals is allotted into sub-alerts of low additionally high frequencies correspondingly.

a. Binary Phase Shift Keying

In BPSK, the phase of the sinusoidal carrier is changed according to the data being transmitted. Symbol 0 or 1 modulates the carrier.

Let the carrier signal be given by

$$s(t) = A \cos(2\pi f_c t)$$

Then $P = \frac{1}{2}A^2 \Rightarrow A = \sqrt{2P}$

When a symbol is changed, the phase of the carrier is changed by π so that we end up with the following signals;

$$s_1(t) = \sqrt{2P}\cos(2\pi f_c t)$$

When a Bit 1 transmitted, and

$$s_2(t) = \sqrt{2P}\cos(2\pi f_c t + \pi)$$

Hence

$$s_2(t) = -\sqrt{2P}\cos(2\pi f_c t)$$

When a Bit 0 is sent.

Hence, Define

$$s(t) = b(t)\sqrt{2P}\cos(2\pi f_c t)$$

with $b(t) = 1$ for binary 1 sent and $b(t) = 0$ for binary 0 sent.

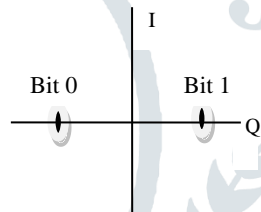


Fig 1: BPSK constellation diagram

Fig.1 shows the symbols constellation, which basically is the representation of the complex envelope of the signal. The distance between the signals on the constellation determines how well the receiver can differentiate between all possible symbols when the signal has been corrupted by noise or when noise is present[8]. The larger the distance, the better is the chance of correct symbol detection. The smaller the distance between the symbols, the greater is the risk of the receiver failing to differentiate between the received symbols that are whether the bit is a 0 or a 1.

In the generation of BPSK signals, the binary data stream is converted into an NRZ bipolar signal by an NRZ encoder. Then it is applied to a product modulator whose output is the BPSK signal.

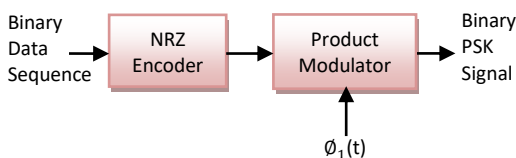


Fig 2: Generation of BPSK signals

2. FFT BASED MU-MIMO-OFDM

MIMO (Multi-input Multi-output) techniques use many antennas at either the transmitter or receiver (array of antennas) in wireless communication systems. The MIMO has been developed for the past few years for Wi-Fi systems. Solitary of the earliest MIMO to Wi-Fi communications makes use of came in mid1980 by using the breakthrough trends via Jack Winters and Jack of Bell Laboratories. Later then, a quantity of academics as well as engineers has completed essential contributions in the area of MIMO. Now MIMO technology has aroused curiosity considering of its viable functions in digital TV, Wi-Fi nearby discipline networks, metropolitan area networks and cellular conversation. Comparing to the Single input- single-output (SISO) method MIMO presents more suitable approach efficiency underneath the equal transmission stipulations. First, MIMO procedure broadly raises the channel capability, which is in proportional to the whole number of transmitter and receiver arrays. Second, MIMO system supplies the skills of spatial variety, each one transmitting sign is detected by way of the whole detector array, which was most effective multiplied process robustness and reliability, but in addition reduces the impact of ISI (inter symbol interference) and the channel fading, considering the fact that every sign choice is situated on N detected outcome. In different phrases, spatial variety over's N impartial replicas of transmitted signal. 1/3, the Array acquire can be expanded, which means SNR obtain achieved with the aid of focusing vigor in desired path is expanded. On the opposite hand, MIMO also rate more power including both the transmission power and the circuit power consumption.

The block diagram representation of Transmitter and Receiver of FFT based MIMO OFDM is shown in Fig.3 & Fig.4 respectively. In the Transmitter block diagram, the input data is encoded and send through the signal mapper. Then, it is passed through a Space Time Block Coder (STBC) where the signal is splitted and inverse FFT is perform on the output of STBC. Guard Interval is added for the inversed transformed signal so as to avoid the channel interference and transmitted through multiple

antennas. The receiver operation is quite the reverse of transmitter operation.

bands as well as encrypt every band separately established on their spectrum vitalities is known as

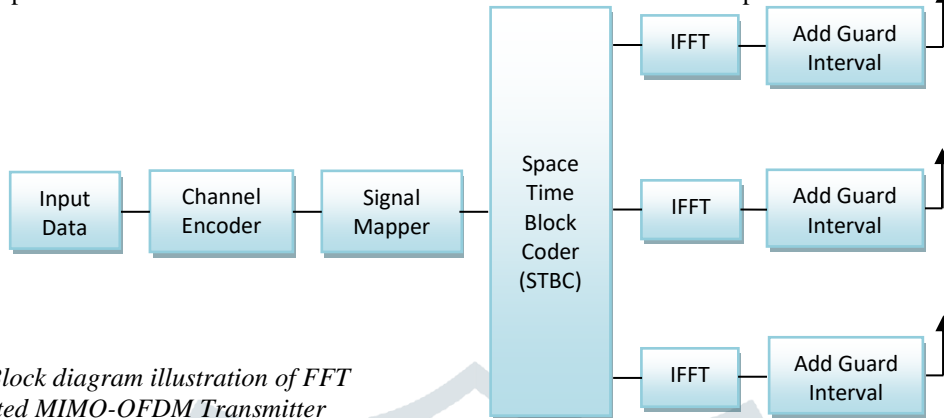


Fig3: Block diagram illustration of FFT situated MIMO-OFDM Transmitter

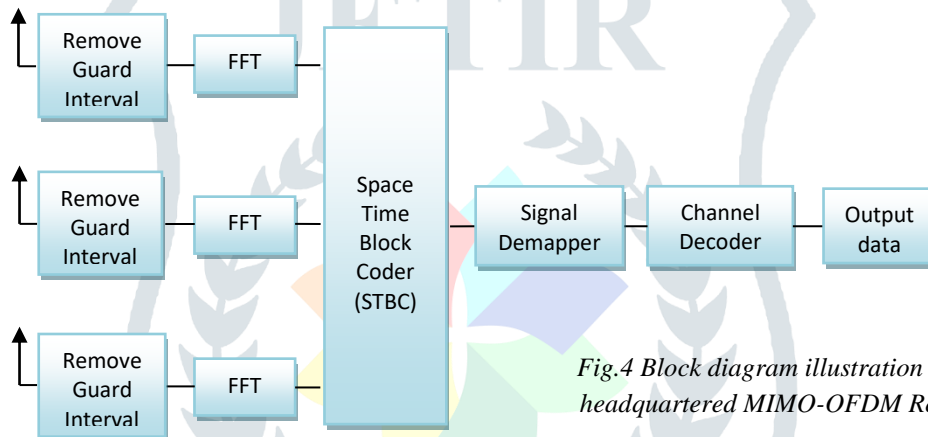


Fig.4 Block diagram illustration of FFT headquartered MIMO-OFDM Receiver

3. WAVELET BASED MU-MIMO-OFDM

Wavelet grow to be is an essential mathematical perform, considering as a tool for multi resolution disintegration of continuous time signal with the aid of exceptional frequencies also exclusive times [5]. Now wavelet develops into a higher frequencies that are superior determined in time, as well as lesser frequencies are better decided in frequency. Going down this mind, the sign stays reproduced via orthogonal wavelet intent, in addition calculated independently changed constituents of the time area signal [9]. The wavelet also be categorized as two classes, steady ripple transform and discrete ripple transform.

The Discrete Ripple could be discovered by way of sub-band coding. The signal is analyzed and it approved over a succession of filter banks [7]. The splitting the full-band source signal altered frequency

sub-band coding method. The learning of sub-band coding fright starting the digital filter bank scheme, it's represented as a set of filters with has altered centre frequencies. Double channel filter bank is usually used moreover the mighty approach to software the discrete ripple transform (DRT) [5][8]. Naturally, the filter financial institution concept has double steps which might be utilized in signal transmission scheme. Step one is named as evaluation stage which agrees toward the decomposition system in which the signal samples stay condensed by using double (down sampling). An extra step is referred to as synthesis interval which concurs to the exclamation method where the sign samples are improved by two (up sampling).

$$\text{Also, } \sqrt{2P} = \sqrt{\frac{2E_b}{T_b}} \quad \text{with } E = \frac{1}{2} A^2 T_b,$$

where T_b is the bit duration. Therefore

$$s_1(t) = \sqrt{\frac{2E_b}{T_b}} \text{Cos}(2\pi f_c t)$$

for binary 1 and

$$s_2(t) = -\sqrt{\frac{2E_b}{T_b}} \text{Cos}(2\pi f_c t)$$

for binary 0 sent. Hence, defining

$$\phi_{12}(t) = \pm \sqrt{\frac{2}{T_b}} \text{Cos}(2\pi f_c t) \text{ for } 0 \leq t \leq T_b,$$

then the signal set of the BPSK signal is

$$s(t) = \{\sqrt{E_b}\phi_1(t), -\sqrt{E_b}\phi_2(t)\}$$

The analysis period includes of sub-band filter surveyed by using down sampler at the same time the synthesis period involves of sub-band filter situated subsequent up sampler. The sub-band filter period used via the channel filter exhibits superb restoration Quadrature mirror Filter (QMF) [9]. Due to this fact there are low pass filter as well as high pass filters at every level, the analysis interval takes double output

coefficients additionally they're named as estimate coefficients which incorporate the small frequency know-how of the sign then element coefficients which incorporate the excessive frequency knowledge of the signal. The analysis interval of the multi-level double channels impeccable restoration filter financial institution scheme is charity for formative the DWT coefficients [5]. The procedure of restoration the foundation sign as of the DWT coefficients is so-referred to as the inverse discrete Ripple Transform (IDRT). Geared toward every level of restoration filter financial institution the calculation then details coefficients are up sampled moreover to hand over low pass filter and high pass synthesis filter.

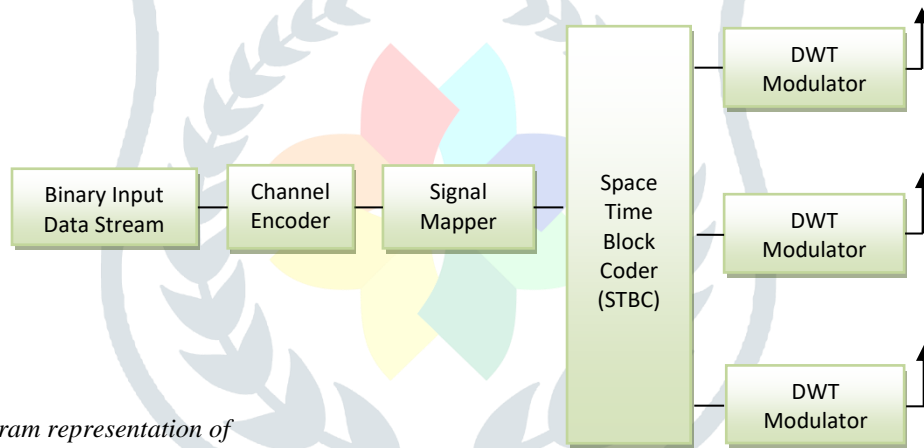


Fig 5: Block diagram representation of DWT based MIMO-OFDM Transmitter

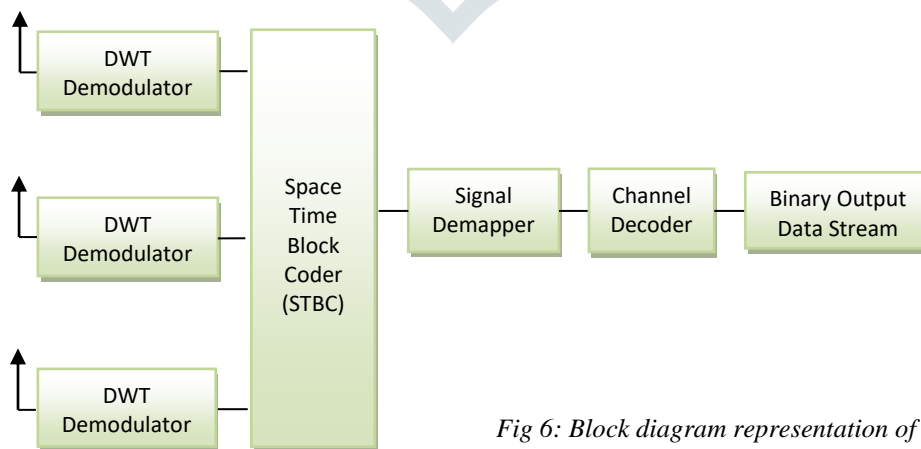


Fig 6: Block diagram representation of DWT based MIMO-OFDM Receiver

4. SIMULATION RESULTS

Fig.7, Fig.8 & Fig.9 show the graphical representation of theory and practical approach of Daubechies, Symtel and Haar wavelets respectively. It can be shown from the simulated results that the Haar mother wavelet supersedes the other two in the performance. The simulation results are based on BER (Bit Error Rate) versus SNR (Signal to Noise Ratio) for QPSK modulation scheme under the Single Input Single Output OFM systems. The performance analysis of the DWT (Haar) based MIMO OFDM system is shown in Figure 10. Figure 11 and 12 shown the graphical representation of FFT based MIMO-OFDM and DWT based MIMO-OFDM for 10000 and 1000000 transmitted bits of each user. Here a 64 user case is considered with two antennas both at the transmitter and at the receiver. The simulation results are based on the comparison between FFT based multi-carrier modulation and DWT based multi-carrier modulation using BPSK in AWGN channel. The probability of bit error rate for DWT based MIMO-OFDM is fewer than the probability of bit error rate for FFT based MIMO-OFDM system. Evaluation between DWT based multicarrier as well as conventional OFDM in relationships of capability (the transmitted symbol measured bits each single multicarrier symbol) then the bandwidth consumption efficiency (the proportion between the distance of subcarrier that transmit data above the overall multicarrier symbol interval). This one is perceptible that the realizable capacity after with DWT as multicarrier is higher than the conventional OFDM whether the guard intervals exist or not.

Fig7: QPSK based MIMO-OFDM using Daubechies Wavelet

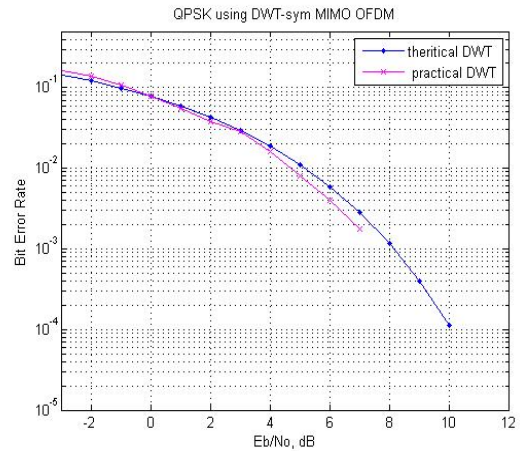


Fig 8: QPSK based MIMO-OFDM using Symtel Wavelet

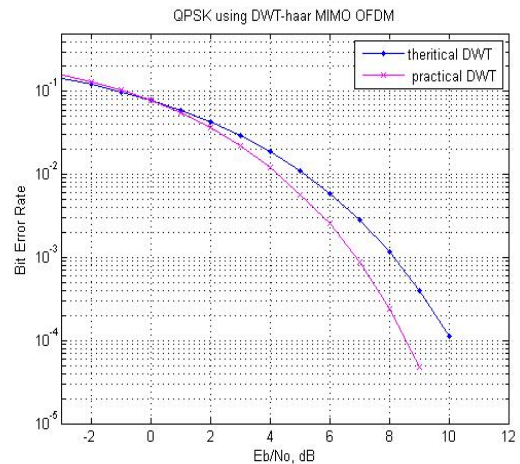


Fig 9: QPSK based MIMO-OFDM using Haar Wavelet

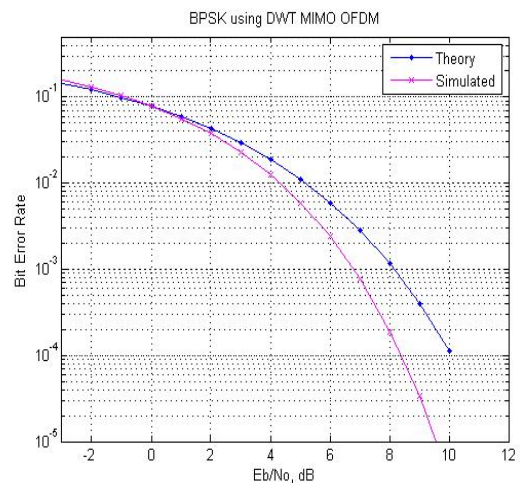
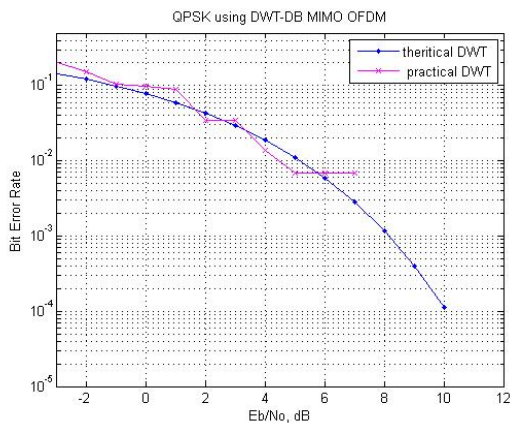


Fig 10: BER vs Eb/No for DWT based MIMO-OFDM for BPSK Modulation Scheme

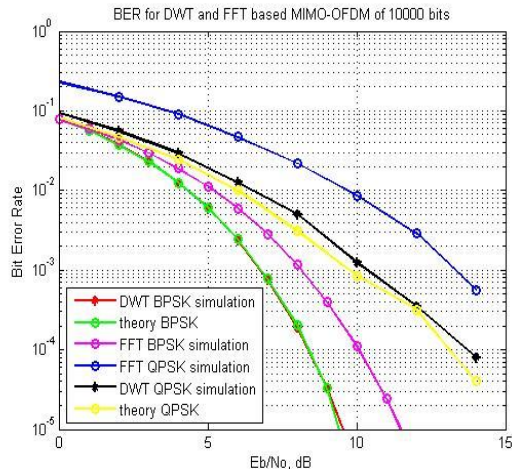


Fig 11: BER vs E_b/N_o for FFT and DWT based MIMO-OFDM for 10000 bits

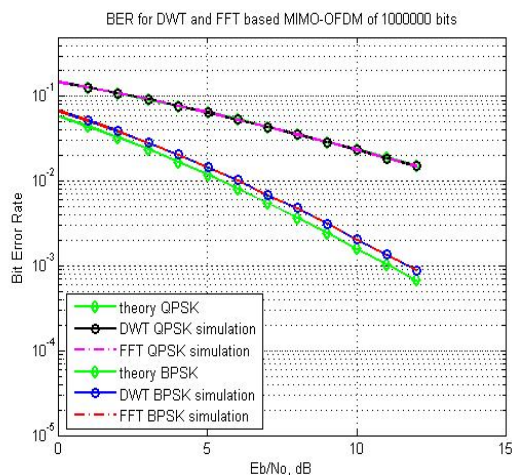


Fig 12: BER vs E_b/N_o for FFT and DWT based MIMO-OFDM for 10^6 bits

CONCLUSION

To fortify the conversation performance MIMO is the satisfactory one. By the use of comparing the simulation results DWT centered MIMO-OFDM is first-rate which is centered upon the probability of bit error price and transmission capacity. As there's no need for cyclic prefix i.e. the periodic extension, in which last part of OFDM information is appended to the first part of OFDM knowledge. To acquire bigger knowledge cost, the DWT established MIMO-OFDM is better than the FFT headquartered MIMO-OFDM. DWT based MIMO-OFDM is an major system in brand new Wi-Fi communication process for reaching excessive knowledge price with low bit error fee. Therefore it was located from the outcomes

of BER upsurges linearly through the whole number of acquire antennas due to upsurge in diversity demand, also to the antenna array improvement wherein further receive antennas assets acquire extra vigor. The BER presentation of communiqé schemes with binary phase shift keying (BPSK) is sophisticated than by Quadrature amplitude modulation (QPSK). Although, the data price by means of QPSK is bigger to BPSK.

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