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BIT ERROR RATE PERFORMANCE ENHANCEMENT OF ORTHOGONAL FREQUENCY DIVISION MULTIPLEXING

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ABSTRACT

Orthogonal Frequency Division Multiplexing (OFDM) is a bandwidth efficient signaling scheme for wide band digital communications. A general problem found in high speed communication is Inter-Symbol Interference (ISI). ISI occurs when a transmission interferes with itself and the receiver cannot decode the transmission correctly. Orthogonal frequency division multiplex (OFDM) modulation is being used more and more in telecommunication, wired and wireless. DVB and DAB already use this modulation technique and ADSL is based on it. The advantages of this modulation are the reason for its increasing usage. OFDM can be implemented easily, it is spectrally efficient and can provide high data rates with sufficient robustness to channel imperfections. Multiple-input-multiple-output and orthogonal frequency division multiplexing (MIMO-OFDM) systems provide high spectral efficiency for wireless communication system. However, they have a major drawback of high peak to-average power ratio (PAPR) which results in inefficient use of a power amplifier. . Thus, many studies have sought to develop PAPR reduction methods. The purpose of this paper is to enhance the Bit Error Ratio (BER) of a transmission varies when Signal to Noise Ratio (S/N Ratio) is changed on transmission channel and also we reduced the peak average power ratio. Here we discussed commanding of OFDM signal in time domain to reduce PAPR and also we discussed how ISI is reduced.

Keywords: bit error rate (BER), orthogonal frequency-division multiplexing (OFDM), energy efficient, inter symbol interference (ISI), multiple input–multiple-output (MIMO), signal to noise ratio(S/N ratio).

1. INTRODUCTION

Orthogonal Frequency Division Multiplexing (OFDM), a special form of Multi carrier Modulation (MCM) with densely spaced subcarriers and overlapping spectra was patented in the U.S. in 1970 [2]. OFDM abandoned the use of steep band pass filters that completely separated the spectrum of individual subcarriers, as it was common practice in older Frequency Division Multiplex (FDMA) systems (e.g. in analogue SSB telephone trunks), in Multi-tone telephone modems and still occurs in Frequency Division Multiple Access radio. Instead, OFDM time-domain waveforms are chosen such that mutual orthogonality is ensured even though subcarrier spectra may overlap. It appeared that such waveforms can be generated using a Fast Fourier Transform at the transmitter and receiver [3, 4]. For a relatively long time, the practicality of the concept appeared limited. Implementation aspects such as the complexity of a real-time Fourier Transform appeared prohibitive, not to speak about the stability of oscillators in transmitter and receiver, the linearity required in RF power amplifiers and the power back-off associated with this. OFDM is a method of encoding digital data on multiple carrier frequencies. OFDM has developed into a popular scheme for wide band digital communication, whether wireless or over copper wires, used in applications such as digital television and audio broadcasting, DSL Internet access, wireless networks, power line networks, and 4G mobile communications.

High-data-rate transmission over mobile or wireless channels is required by many applications. However, the symbol duration reduces with the increase of the data rate, and dispersive fading of the wireless channels will cause more severe inter symbol interference (ISI) if single-carrier modulation, such as in time-division multiple access (TDMA) or Global System for Mobile Communications (GSM), is still used. From [5], to reduce the effect of ISI, the symbol duration must be much larger than the delay spread of wireless channels. In orthogonal frequency-division multiplexing (OFDM) [6]-[8], the entire channel is divided into many narrow-band sub channels, which are transmitted in parallel to maintain high-data- rate transmission and, at the same time, to increase the symbol duration to combat ISI. Channel equalization is simplified because OFDM may be viewed as using many slowly modulated narrowband signals rather than one rapidly modulated wideband signal.

We propose a linear pre-coding scheme for a single user multiple-input-multiple-output orthogonal frequency division multiplexing (OFDM) system to minimize peak to average power ratio (PAPR) by using redundant spatial resources at the transmitter through a singular value decomposition based generalized inverse. The proposed pre-coder based on the generalized inverse is composed of two parts. One is for minimizing PAPR, and the other is for obtaining the multiplexing gain. Also, the proposed pre-coder contains a scalar parameter that quantifies the received signal-to-noise power ratio (SNR) loss at the cost of PAPR reduction. Even in cases of small

SNR loss, the proposed scheme dramatically reduces PAPR.

Multiple-input-multiple output and orthogonal frequency division multiplexing (MIMO-OFDM) systems provide high spectral efficiency for wireless communication system. However, they have a major drawback of high peak to-average power ratio (PAPR) which results in inefficient use of a power amplifier Thus, many studies have sought to develop PAPR reduction methods. For single-input single-output (SISO) OFDM, the authors of presented an efficient algorithm based on the iterative clipping and filtering (ICF) process, and an optimized ICF method effectively reduced PAPR.

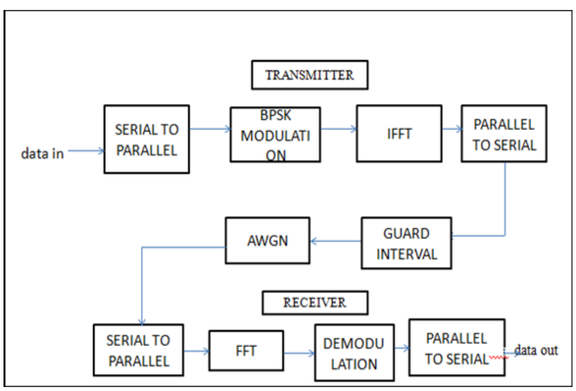
2. PROPOSED SYSTEM

A general problem found in high speed communication is Inter-Symbol Interference (ISI). ISI occurs when a transmission interferes with itself and the receiver cannot decode the transmission correctly. Orthogonal frequency division multiplex (OFDM) modulation is being used more and more in telecommunication, wired and wireless. DVB and DAB already use this modulation technique and ADSL is based on it. The advantages of this modulation are the reason for its increasing usage. OFDM can be implemented easily, it is spectrally efficient and can provide high data rates with sufficient robustness to channel imperfections.

Advantages of proposed system

- Peak average power ratio is reduced.
- Low bit error rate.
- PSNR value is increased.
- Inter symbol interference is decreased.

3. BLOCK DIAGRAM DESCRIPTION



a) Modulation and demodulation process

The modulation and demodulation process the data transmission done it as between the channels that as guard band channel estimated values has been mainly depends on an transmitted value based off to be done. The transmission part refers it as the modulation consists, the modulation done as based on the transformation applied here, the transformation process consists as that the nFFT used, nFFT is a non equispaced fast Fourier transformation.

The de-modulation process in that as the inverse transformation is to be applied, the inverse transformation is an IFFT used of done, IFFT is a INVERSE FAST FOURIER TRANSFORMATION. Here after the channel estimated has been defined as by the removal of an additionally added channel effects. after that this process the channel coded value has been defined. Therefore finally the channel threw sending and receiving data's are to be pre determined by the way of estimation in channels.

b) Operation

Binary Data input is given in the form of (0, 1) in a modulation input b(t). Its for a given input signals to generate a data for an modulating input data. A Serial to Parallel conversion of a given input signal is to be modulated by a transmitted signal. Bits insertion in the form of parallel views as called inserting bits to an operation. Its output denoted as d(k). Pilot insertion is used to avoid the overlapping of two signals. The IFFT & FFT Transforms are used as an applying transform domain data & normalizing data. IFFT converts time domain signal in to frequency domain signal. FFT converts frequency domain signal in to time domain signal. Adding prefix cycles Xg(n) for the cyclic insertion operation, after the transformed data's are to be cyclic prefix data's are operated for an insertion. Parallel data is to be converted into serial data in the form of serialized data is to be given threw wave channel for demodulating processes. The conversion of a digital to analog signal for an demodulation processes proceeded for an given input data's are analyzed. The channel operation is for that as demodulation process. The modulated signal as to be given input in the form of serial data's. The form of serial data is to be converted into parallel form for an demodulation operation. For a demodulation process the cyclic prefixed data's are to be removed. The demodulation processes the inserted and modulated pilot values that are removed and demodulated. The FFT and IFFT transforms are modulated as to be again modulated for an demodulation. The error rate calculations are to be measured in that for a given bits modulated and demodulated functions. ISI for an inter symbol interference for a cyclic prefix inserted in guard interval to suppress the Inter Symbol Interference for an equalized frequency maintenance. The demodulated outputs are in the form as getting in the serialized data's to be measured.

4. SIMULATION AND RESULTS

a) BER

The channel experienced by each subcarrier in an OFDM system is a flat fading channel with each subcarrier. So, assuming that the number of taps in the channel is lower than the cyclic prefix duration (which ensures that there is no inter symbol interference), the BER for OFDM.

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The CFO significantly degrades the achievable BER performance of OFDM systems. When there is no CFO, there are no bit errors, since we stated before that we have ignored the effects of background noise. When the normalized CFO is low, the BER increases exponentially with the normalized CFO. Again, it shows that the results obtained from our exact analysis and those accruing from our simulations match well for various numbers of OFDM subcarriers. The BER vs. SNR carves for OFDM system are obtained for different system parameters. The analysis of the obtained results shows that the developed model can efficiently simulate and demonstrate the effect of changing of OFDM system parameters.

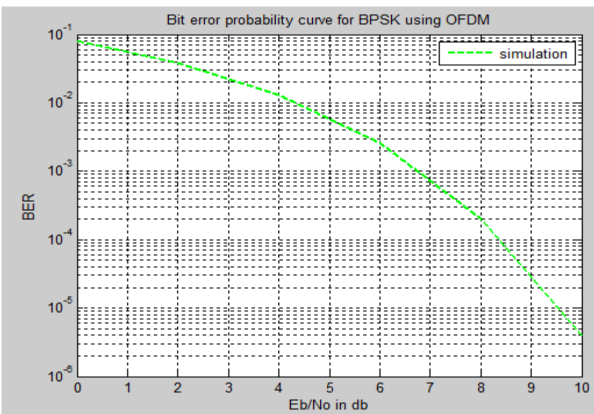

Figure-1. Bit error probability curve for modulation and DE-modulation process.

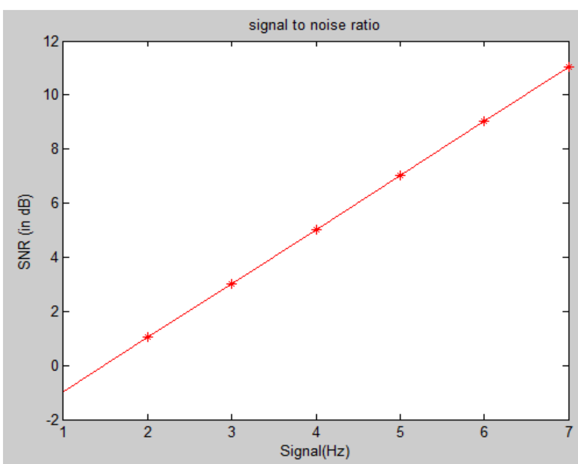

Figure-2. Signal to noise ratio.

Here the bit error ratio for both modulation and De-modulation process is decreased and the signal to noise ratio is increased.

b) PAPR

The first set is involved with finding the overall maximum PAPR that can be occurred. But, since this maximum PAPR rarely occurs, then the PAPR performance must be evaluated thoroughly using the Complementary Cu-mulative Distribution Function which relates directly with the second set of simulations. Assuming that all samples do not correlate with each other, the probability that PAPR ratio can be under a certain threshold. Many researchers have involved with Distribution of OFDM PAPR. Van Nee proposed that Distribution of N carriers with oversampling, can be approximated with αN carriers without oversampling. Also, by taking into consideration that the effect of oversampling is approximated by inserting additional independent samples

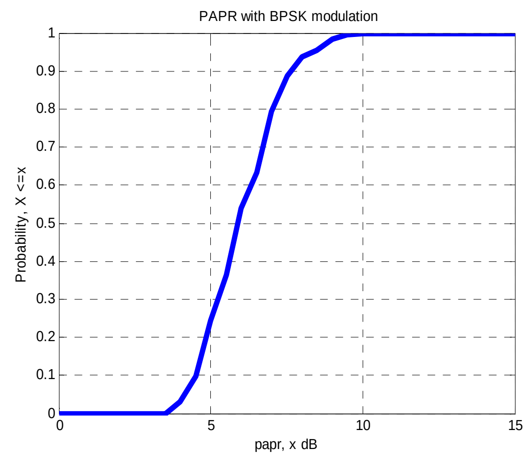

Figure-3. Peak average power ratio curve.

intuitively, the maximum amplitude should be minimized while the average power consumption is maintained at a certain level. Thus, we can intuitively predict that the constant would be selected close to 1 when PAPR negligibly affects the error rate performance so that pre-coding gain is more critical than PAPR performance.

However, it is noted that minimizing the maximum amplitude at the expense of the received SNR loss does not always guarantee the peak to average power ratio reduction due to the variation of the average transmission power.

The Zero-Forcing Equalizer applies the inverse of the channel frequency response to the received signal, to restore the signal after the channel. The zero-forcing equalizer removes all ISI, and is ideal when the channel is noiseless. However, when the channel is noisy, the zero-forcing equalizer will amplify the noise greatly at frequencies f where the channel response $H(j2\pi f)$ has a small magnitude (i.e. near zeroes of the channel) in the attempt to invert the channel completely.

Peak average power ratio is reduced and inter symbol interference are also decreased here.

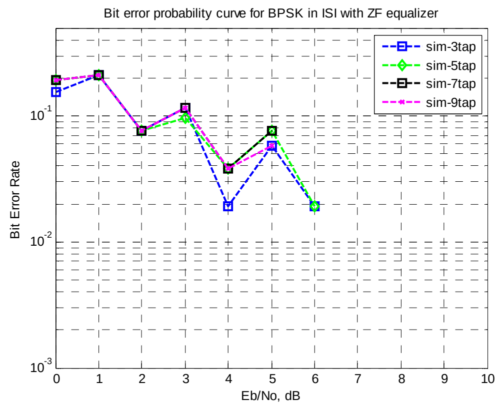

Figure-4. Bit error probability curve for BPSK in ISI with ZF equalizer.

c) PSD

The PSD is normalized to the mean power of the data sub carriers. Power density is the single most important operating parameter for transmitting earth stations and probably the least understood by operators of communication terminals. Its how easy to exceed the regulatory limit and the problems that result and, finally, what we can do to reduce these problems to an acceptable level. Most terminal operators can tell how much power they are transmitting and what data rates they are achieving up and down. This is good information to know, but it is not good enough to ensure that the terminal is operating at its best and within regulatory limits. The official document issued by the satellite operator or regulatory agency that authorizes a terminal to transmit specifies its maximum allowed power density.

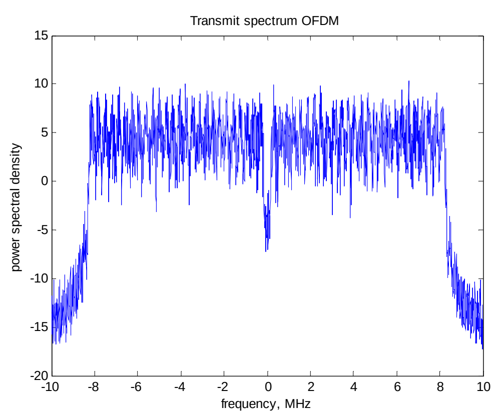

Figure-5. Power spectral Density curve.

The factor turns the ICI mitigation scheme into a variety of frequency or RB allocation algorithms in which the objective of optimization is to reduce the ICI and achieve higher spectral efficiency simultaneously, especially for the CEUs. From, it can be seen that the interference can significantly decrease when the serving cell transmits data on RBn if the neighbouring cells do not allocate the RBn to their UEs, The granularity of the allocation can be a RB or a portion of the available bandwidth. The concept to reserve parts of the bandwidth to avoid interference is classified as a frequency reuse technique based on done.

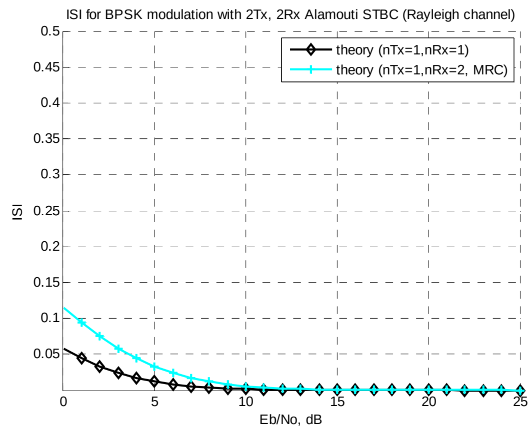

Figure-6. Inter symbol interference for BPSK modulation.

d) CCDF Vs PAPR

The analysis of Orthogonal frequency division multiplexing (OFDM) signals. CCDF curves are known to have great importance in the study of signal performance on the basis of power level. This paper presents the CCDF performance of the OFDM signal with different number of carriers. Simulation is used to implement the CDF equation and its accuracy is checked on the result.

A CCDF curve shows how much time the signal spends at or above a given power level. The power level is expressed in dB relative to the average power. A CCDF curve is basically a plot of relative power levels versus probability. Mathematically CCDF can be explained with a set of data having the probability density function (PDF). To obtain the Cumulative Distribution Function (CDF), the integral of the PDF is computed. Then inverting the CDF results in the CCDF. It concludes that the CCDF is the complement of the CDF or CCDF = 1 – CDF

PAPR is the ratio between the maximum power and the average power of the complex pass band signal.

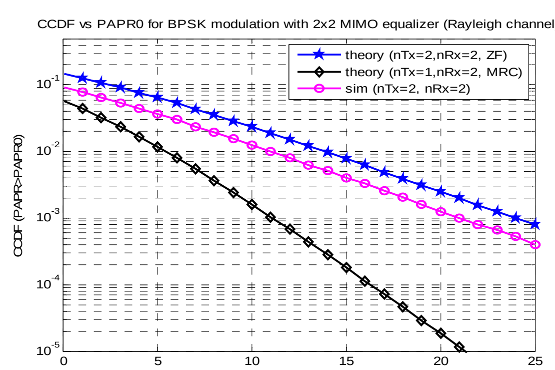

Figure-7. CCDF VS PAPR.

Table-1. Tabulation for OFDM output.

Eb/No. (db)	Bit error ratio for Modulated output	Bit error ratio for De-modulated output	Signal to noise ratio (db)	ISI
0	0.07955	0.07865	0	0.1346
2	0.03935	0.03751	1.031	0.09615
4	0.01282	0.0125	5.031	0.038469
6	0.002571	0.002388	9.031	0.05769
8	0.0001712	0.0001909	14.031	0.01923

5. CONCLUSIONS

Orthogonal Frequency Division Multiplexing (OFDM) is a bandwidth efficient signaling scheme for wide band digital communications. A general problem found in high speed communication is Inter-Symbol Interference (ISI). ISI occurs when a transmission interferes with itself and the receiver cannot decode the transmission correctly. Orthogonal frequency division multiplex (OFDM) modulation is being used more and more in telecommunication, wired and wireless. DVB and DAB already use this modulation technique and ADSL is based on it. The advantages of this modulation are the reason for its increasing usage. OFDM can be implemented easily, it is spectrally efficient and can provide high data rates with sufficient robustness to channel imperfections. In this paper we enhanced the performance of Bit Error Ratio (BER) when Signal to Noise Ratio (S/N Ratio) is changed on transmission channel. Here Bit Error Rate (BER) is reduced and Signal to Noise Ratio(S/N Ratio) is improved. CCDF plots provide an efficient method for the analysis of the PAPR of the OFDM signal. PAPR and ISI also reduced here.

REFERENCES

[1] Sheng Bin. 2014. "An Energy Efficient Transmission Scheme for OFDM Systems in LTE," IEEE Journals and magazines, Vol. 11.

[2] R. W. Chang. 1966. "Synthesis of band limited orthogonal signals for multichannel data transmission", Bell Systems Technical Journal, Vol. 45, pp. 1775-1796, December.

[3] S. B. Weinstein and P. M. Ebert. 1971. "Data Transmission by Frequency--Division Multiplexing Using the Discrete Fourier Transform", IEEE Tans. Commun. Technol., Vol. COM--19, No.5, pp.628-634, October.

[4] B. Hirosaki. 1981. "An Orthogonal--Multiplexed QAM System Using the Discrete Fourier Transform", IEEE Tans. Commun. Technol. Vol. COM--29, No.7, pp.982- 989, July.

[5]Hua Zhang, Ye (Geoffrey) Li, Victor Stolpman and Nico van Waes. 2007. "A Reduced CSI Feedback Approach for Precoded MIMO-OFDM Systems", IEEE Transactions on wireless communication, Vol. 6, no. 1, January.

[6] Guowang Miao, Nageen Himayat and Geoffrey. 2010. "Energy-Efficient Link Adaptation in Frequency-Selective channels", IEEE transactions on communications, Vol. 58, no. 2, February.

[7] Zhiqiang Liu and T. C. Yang. 2012. "On the Design of Cyclic Prefix Length for Time-Reversed OFDM" IEEE transactions on wireless communications, Vol. 11, no. 10, October.

[8] Chuang. 1987. "The effects of time delay spread on portable radio communications channels with digital modulation," IEEE J. Sel. Areas in Communication., Vol. SAC-5, no. 5, pp. 879–889, June.

[9] L. J. Cimini, Jr. 1985. "Analysis and simulation of a digital mobile channel using orthogonal frequency division multiplexing," IEEE Trans. Commun., Vol. COM-33, no. 7, pp. 665–675, July.

[10] S. Weinstein and P. Ebert. 1971 "Data transmission by frequency-division multiplexing using the discrete Fourier transform," IEEE Trans. Commun. Technol., Vol. COM-19, no. 5, pp. 628–634, October.

[11] Y. (G.) Li and G. Stüber. 2006. "Orthogonal Frequency Division Multiplexing for Wireless Communications", Jan.

[12] Wang j, chen j. 2001. "Performance of wideband CDMA with complex spreading and imperfect channel estimation ". IEEE Journal of Selected Areas in Communications. Vol. 19, no. 1, pp. 52-163.

ARPN Journal of Engineering and Applied Sciences

[13] Zhang Yong, Jiang Dajie and Shen Xiaodong. 2008. "The system performance for TD-LTE with precoded MIMO ". China Communications, Vol. 3: 90-9.

[14] Li Ye, Cimini Lj and Sollenberger N. 1998. "Robust channel estimation for OFDM systems with rapid dispersive fading channels". IEEE Transactions on Communications, Vol. 46, no. 7, pp. 902-915.

[15] Yang Baoguo, Letaief Kb and Cheng Rs. 2001. "Channel estimation for OFDM transmission in multipath fading channels based on parametric channel modeling". IEEE Transactions on Communications, Vol. 49, no. 3, pp. 467-479.