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REDUCTION OF PAPR IN OFDM SYSTEM USING REPEATED CLIPPING AND FILTERING TECHNIQUE WITH DIFFERENT MODULATION SCHEMES

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ABSTRACT

Communication is one of the important aspects of life. With the advancement in age and its growing demands, there has been rapid growth in the field of communications. Signals, which were initially sent in the analog domain, are being sent more and more in the digital domain these days. For better transmission, even single carrier waves are being replaced by multi carriers. Multi carrier systems like CDMA and OFDM are now days being implemented commonly. In the OFDM system, orthogonally placed sub carriers are used to carry the data from the transmitter end to the receiver end. Presence of guard band in this system deals with the problem of ISI and noise is minimized by larger number of sub carriers. But the large Peak to Average Power Ratio of these signal have some undesirable effects on the system. In this paper we have proposed the reduction of PAPR by using repeated clipping and filtering technique.

***Keywords:* OFDM, IFFT, PAPR, CCDF, Repeated Clipping &Filtering.**

I INTRODUCTION

New Technologies and thereby new applications are emerging not just in wired environment but also in the wireless arena. The next generation mobile systems are expected to provide a substantially high data rate to meet the requirements of future high performance multimedia applications. The minimum target data rate for the 4G system is expected to be at 10-20 Mbps and at least 2 Mbps in the moving vehicles. To provide such a high data rate with high spectral efficiency, a new modulation scheme is to be used. A promising modulation technique that is increasingly being considered for adoption by 4G community is OFDM [6]. Existing 3G systems uses single carrier modulation technique whereas OFDM OFDM employed in Digital Television Broadcasting (such as the digital ATV Terrestrial Broadcasting) [8], European Digital Audio Broadcasting (DAB) and Digital Video Broadcasting Terrestrial (DVB-T), Wireless Asynchronous Transfer Mode (WATM) and which is otherwise known as

Multicarrier Modulation (MCM)/Discrete Multitone Technique (DMT) sends a high speed data stream by splitting it up to multiple lower speed stream and transmitting it over a lower bandwidth subcarriers in parallel. OFDM has several favorable properties like high spectral efficiency, robustness to channel fading, immunity to impulse interference, uniform average spectral density, capacity to handle very strong echoes and less non-linear distortion. OFDM is the modulation technique used in many new broadband communication systems. In recent years OFDM has emerged as the standard of choice in a number of important high data applications.

II ORTHOGONAL FREQUENCY DIVISION MULTIPLEXING (OFDM)

OFDM is a Multicarrier Transmission technique which divides the available spectrum into many carriers each one being modulated by a low data rate stream. OFDM [6] is similar to Frequency Division Multiple Access (FDMA) in that the multiple user access is achieved by sub-dividing the available bandwidth into multiple channels, which are then allocated to users. However OFDM uses the spectrum much more efficiently by spacing the channels more closely together. This is achieved by making all the carriers orthogonal to one another, preventing interference between the closely In FDMA each user is typically allocated a single channel which is used to transmit all the user information. The bandwidth of each channel is typically 10-30 kHz for voice communication. However, the minimum required bandwidth for speech is only 3 kHz. The allocated bandwidth is made wider than the minimum amount required to prevent channels from interfering with one another. This extra bandwidth is to allow for signals of neighboring channels to be filtered out and to allow for signals of neighboring channels to be filtered out and to allow for any drift in the center frequency of the transmitter or receiver. In a typical system up to 50% of the total spectrum is wasted due to extra spacing between channels. This problems worse as the channel bandwidth becomes narrower and the frequency band increases Time Division Multiple Access (TDMA) overcomes this problem by using wider band width channels which are used by several users. The subcarriers [11] in an OFDM signal are spaced close as is theoretically possible which maintain othogonality between them. The orthogonality of the carriers means that each carrier has an integer number of cycles over a symbol period. Due to this the spectrum of each carrier has a null at the center frequency of each of the other carriers in the system. This results in no interference between the carriers, allowing them to be spaced as close as theoretically possible.

III OFDM SYSTEM MODEL

To generate OFDM successfully the relationship between all the carriers must be carefully controlled to maintain the orthogonality of the carriers. For this reason, OFDM [6] is generated by firstly choosing the spectrum required based on the input data, and modulation scheme used. Each carrier to be produced is assigned same data to transmit. The required amplitude and phase of them are calculated based on the modulation scheme. The required spectrum is then convertedback to its time domain signal using an Inverse Fourier Transform (IFT). In most applications, an Inverse Fast Fourier Transform (IFFT) is used. The IFFT performs the transformation very efficiently and provides a simple way of ensuring the carrier signals produced are orthogonal. The Fast Fourier Transform (FFT) transforms a cyclic time domain signal into its equivalent frequency spectrum. This is done by finding the equivalent waveform, generated by a sum of orthogonal sinusoidal components. The amplitude and phase of the sinusoidal components represent the frequency spectrum of the time domain signal. The IFFT performs the reverse process, transforming a spectrum (amplitude and phase of each component) in to a time domain signal.

Fig.1 shows the configuration for a basic OFDM Transmitter and Receiver. The signal generated is at base band and so to generate an RF signal, the signal must be filtered and mixed to the desired transmission frequency.

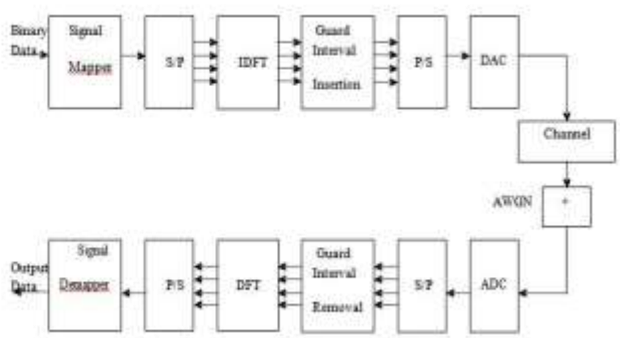

Fig 1 : The basic block diagram of an OFDM system.

IV PROBLEM OF PEAK-TO-AVERAGE POWER RATIO IN OFDM SYSTEMS

High Peak-to-Average Power Ratio has been recognized as one of the major practical problem involving OFDM modulation. High PAPR [10] results from the nature of the modulation itself where multiple subcarriers / sinusoids are added together to form the signal to be transmitted. When N sinusoids add, the peak magnitude would have a value of N, where the average might be quite low due to the destructive interference between the sinusoids. High PAPR signals are usually undesirable for it usually strains the analog circuitry. High PAPR signals would require a large range of dynamic linearity from the analog circuits which usually results in expensive devices and high power consumption with lower efficiency (for e.g. power amplifier has to operate with larger back-off to maintain linearity). In OFDM system [4], some input sequences would result in higher PAPR than others. For example, an input sequence that requires all such carriers to transmit their maximum amplitudes would certainly result in a high output PAPR. Thus by limiting the possible input sequences to a smallest sub set, it should be possible to obtain output signals with a guaranteed low output PAPR. The PAPR of the transmit signal x(t) is the ratio of the maximum instantaneous power and the average power.

V CUMULATIVE DISTRIBUTION FUNCTION

The Cumulative Distribution Function (CDF)[1] is one of the most regularly used parameters, which is used to measure the efficiency of any PAPR technique. Normally, the Complementary CDF (CCDF) is used instead of CDF, which helps us to measure the probability that the PAPR of a certain data block exceeds the given threshold.

VI REDUCTION OF PAPR USING REPEATED CLIPPING & FILTERING TECHNIQUE

High PAPR is one of the most common problems in OFDM. A high PAPR brings disadvantages like increased complexity of the ADC and DAC and also reduced efficiency of radio frequency (RF) power amplifier. One of the simple and effective PAPR reduction techniques is clipping, which cancels the signal components that exceed some unchanging amplitude called clip level. However, clipping yields distortion power, which called clipping noise, and expands the transmitted signal spectrum, which causes interfering [2]. Clipping is nonlinear process and causes in-band noise distortion, which causes degradation in the performance of bit error rate (BER) and out-of-band noise, which decreases the spectral efficiency. Clipping and filtering technique is effective in removing components of the expanded spectrum. Although filtering can decrease the spectrum growth, filtering after clipping can reduce the out-of-band radiation, but may also cause some peak re-growth, which the peak signal exceeds in the clip level [7]. The technique of iterative clipping and filtering reduces the PAPR without spectrum expansion. However, the iterative signal takes long time and it will increase the computational complexity of an OFDM transmitter [12]. But without performing interpolation before clipping causes it out-of-band. To avoid out-of-band, signal should be clipped after interpolation. However, this causes significant peak re-growth. So, it can use repeated clipping and frequency domain filtering to avoid peak re-growth. In the system used, serial to parallel converter converts serial input data having different frequency component which are base band modulated symbols and apply interpolation to these symbols by zero padding in the middle of input data. Then clipping operation is performed to cut high peak amplitudes and frequency domain filtering is used to reduce the out of band signal, but caused peak re-growth [13]. This consists of two FFT operations. Forward FFT transforms the clipped signal back to discrete frequency domain. The in-band discrete components are passed unchanged to inputs of second IFFT while out of band components are null. The clipping and filtering process is performed repeatedly until the amplitude is set to the threshold value level to avoid the peak out-of band and peak re-growth.

VII SIMULATION RESULTS

System Description

Parameters of simulation: N=128, three types of modulation schemes BPSK, QPSK, QAM16 used in simulations.

7.1 PAPR reduction using clipping & filtering tech. with BPSK modulation

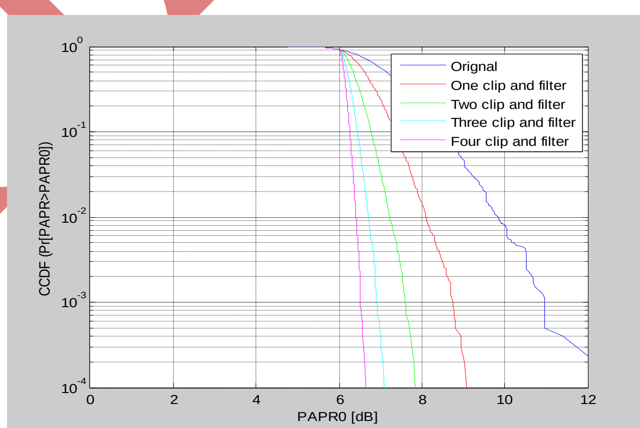

Fig (a) PAPR Reduction using clipping and filtering with BPSK modulation

Result: In figure (a) .PAPR of original signal is 12.5dB. and PAPR at fourth iteration is 6.6dB

7.2 PAPR reduction using clipping & filtering tech. with QPSK modulation.

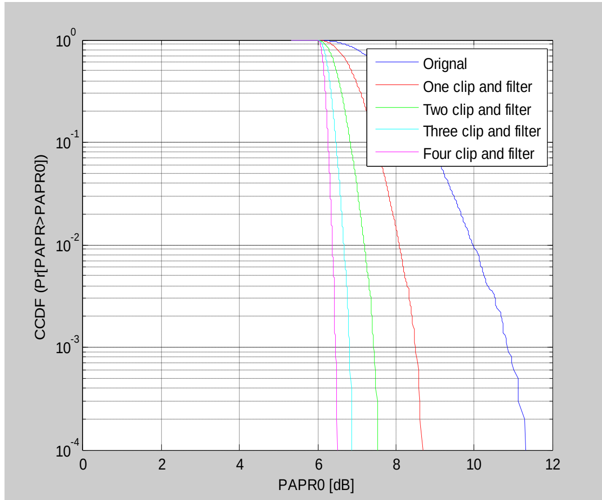

Fig (b) Reduction of PAPR using clipping and filtering with QPSK modulation

Result: In the Figure (b). PAPR of original signal is 11.6dB and PAPR atfourth iteration is 6.5dB

7.3 PAPR reduction using clipping & filtering with 16 QAM modulation.

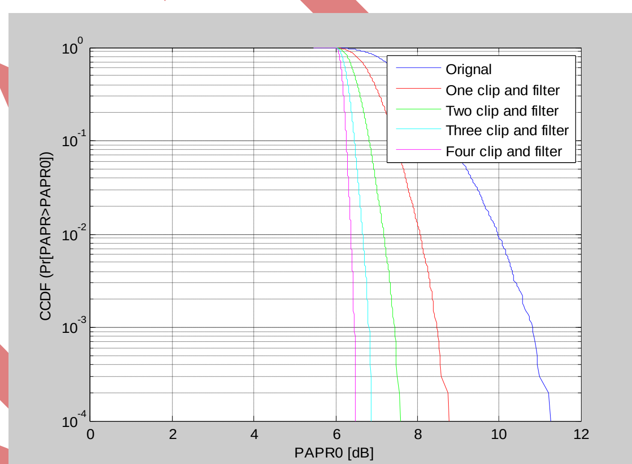

Fig (c) PAPR Reduction using clipping and filtering with 16 QAM modulation

Result: In the Figure (c) PAPR of original signal is 11.4dB and PAPR at fourth iteration is 6.4dB

In an OFDM system repeated clipping and filtering significantly reduce PAPR where modulation schemes are BPSK, QPSK, and QAM16.Through simulation we have found that PAPR of 16QAM is low compared to BPSK and QPSK which gives better result can be seen in figure C. According to the fourth iteration PAPR are given respectively 6.6dB, 6.5dB and 6.4 dB for BPSK, QPSK and 16QAM.

Finally, it can be concluded that 16QAM gives better result compared to the BPSK and QPSK.

VIII CONCLUSION

In this paper we have presented an overview of OFDM. The main aim of this paper is to investigate PAPR problem in OFDM system and its reduction by using repeated clipping and filtering technique. From simulation results it can be concluded that there is considerable reduction in PAPR after applying RCF technique.

REFERENCES

[1] Bauml, R.W., Fischer, R.F.H., and Huber, J.B. "Reducing the peak to average power ratio of multi carrier modulation by selective mapping", IEEE Electronics Letters, Vol.32, Oct 1996.

[2] Li.X. And L.J. Cimini, "Effects of clipping and filtering on performance of OFDM", proceeding if IEEE VTC' 1997.

[3] Muller, S.H., and Huber, J.B., "OFDM with reduced peak to average power ratio by optimum combination of partial transmit sequences" ,IEEE Electronics letters, Vol.33, Feb 1997

[4] Van Nee, R., and Wild,A., "Reducing the peak to average power ratio of OFDM", IEEE Vehicular Technology Conference, Vol.3, may 1998.

[5] May, T., and Rohling , H., "Reducing the peak to average power ratio of OFDM", radio transmission system", IEEE Vehicular Technology Conference, Vol. 3, May 1998.

[6] V.N. Richard and R. Prasad, OFDM for wireless multimedia communication Artech House Publisher, London 2000.

[7] J. Armstrong, "Peak – to – Average Power Reduction for OFDM by Repeated Clipping and Frequency Domain Filtering", Elect. Lett., Vol. 38, No. 8, February 2002.

[8] T. S. Rappaport, "Wireless Communication: Principles and Practice": 2nd Edition, Prentice Hall, 2002.

[9] S. H. Han, J. H. Lee, "PAPR Reduction of OFDM Signals Using a Reduced Complexity PTS Technique", IEEE Signal Processing Letters, Vol. 11, No. 11, November 2004.

[10] S. H. Han, J. H. Lee, "An Overview of Peak to Average Power Ratio Reduction Techniques for Multicarrier Transmission", IEEE Transaction on Wireless Communication, April 2005.

[11] L. D. Kabulepa, "OFDM Basics for Wireless Communications," Darmstadt University of Technology.

[12] Toshiyuki, Shigeru, Masaharu, and Junichiro, "Peak Reduction Improvement in Iterative Clipping and Filtering with a Graded Band Limiting Filter for OFDM Transmission, "IEICE Trans Fundamentals, Vol.E90–A, No.7, 2007.

[13] Masaki Ojima, and Takeshi Hattori, "PAPR Reduction Method using Clipping and Peak-windowing in CI/OFDM System," Sophia University Journal, 2007.

[14] H. Taub, D. L. Schilling, G. Saha, "Taub's Principles of Communication Syste ms": Tata McGraw Hill, 2008.