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PAPR reduction of Coded OFDM signal using Selective Mapping Technique

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Abstract: *Orthogonal Frequency Division Multiplexing (OFDM) is a multicarrier modulation (MCM) technique which seems to be an attractive candidate for fourth generation (4G) wireless communication systems. Peak-to-average Power ratio(PAPR) problem is the major drawback of multicarrier transmission system which leads to power inefficiency.There are various techniques which can be used to reduce PAPR.In this paper Selective mapping technique(SLM) is used to reduce PAPR of coded OFDM signal.*

Keywords: *Orthogonal Frequency Division Multiplexing(OFDM),Quadrature Phase Shift Keying (QPSK), Peak-to-Average Power Ratio(PAPR), Complementary Cumulative Distribution Function (CCDF), Selective Mapping(SLM),Partial Transmit Sequence (PTS).Reed Solomon(RS)*

I. Introduction

Orthogonal frequency division multiplexing (OFDM) is one of the most attractive candidates for fourth generation (4G) wireless communication systems. OFDM offer high spectral efficiency, immune to the multipath delay, low inter-symbol interference (ISI), immunity to frequency selective fading and high power efficiency. Due to these merits OFDM is chosen as high data rate communication systems. However OFDM system suffers from serious problem of high PAPR.In OFDM system output is superposition of multiple sub-carriers.In this case some instantaneous power output might increase greatly and become far higher than the mean power of system.To transmit signals with such high PAPR, it requires power amplifiers with very high power scope. These kinds of amplifiers are very expensive and have low efficiency-cost.If the peak power is too high, it could be out of the scope of the linear power amplifier.This gives rise to non-linear distortion which changes the superposition of the signal spectrum resulting in performance degradation.PAPR can be described by its complementary cumulative distribution function (CCDF). Many PAPR reduction method have been proposed such as clipping method,coding method,selective mapping (SLM) method,Partial transmit sequence(PTS). Clipping method clip the peak above a certain prescribed level.The merit of this clipping method is that PAPR can be easily reduced. But the BER performance becomes very worse due to many defected signals.Block coding is another important method for PAPR reduction.This method can reduce the PAPR without any signal distortion.However, the code rate becomes smaller tha none,so that bandwidth efficiency is very poor.The SLM and PTS may be classified in to the phase control scheme to escape the high peak. In SLM,one signal of the lowest PAPR is selected a set of several signals containing the same information data.In PTS, the lowest PAPR signal is made by optimally phase combining the signal sub-blocks. Both techniques are very flexible scheme and have an effective performance of the PAPR reduction without any signal distortion.We propose to extend distortionless SLM technique which improves PAPR by adding little redundancy.

II. OFDM System

OFDM represents a different system design approach. It can be thought of as a combination of modulation and multiple-access schemes that segments a communications channel in such a way that many users can share it. Whereas TDMA segments are according to time and CDMA segments are according to spreading codes, OFDM segments are according to frequency. It is a technique that divides the spectrum into a number of equally spaced tones and carries a portion of a user's information on each tone. A tone can be thought of as a frequency, much in the same way that each key on a piano represents a unique frequency. OFDM can be viewed as a form of frequency division multiplexing (FDM), however, OFDM has an important special property that each tone is orthogonal with every other tone. FDM typically requires there to be frequency guard bands between the frequencies so that they do not interfere with each other. OFDM allows the spectrum of each tone to overlap, and because they are orthogonal, they do not interfere with each other. Fig 1 Shows OFDM system.

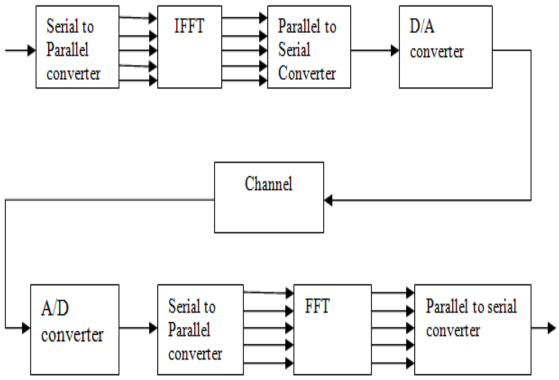

Fig 1 OFDM System

By allowing the tones to overlap, the overall amount of spectrum required is reduced. OFDM is a modulation technique in that it enables user data to be modulated onto the tones. The information is modulated onto a tone by adjusting the tone's phase, amplitude, or both. In the most basic form, a tone may be present or disabled to indicate a one or zero bit of information; however either phase shift keying (PSK) or quadrature amplitude modulation (QAM) is typically employed. An OFDM system takes a data stream and splits it into N parallel data streams, each at a rate 1/N of the original rate. Each stream is then mapped to a tone at a unique frequency and combined together using the inverse fast Fourier transform (IFFT) to yield the time domain waveform to be transmitted.

III. PAPR

The crest factor or peak-to-average ratio (PAR) or peak-to-average power ratio (PAPR) is a measurement of a waveform, calculated from the peak amplitude of the waveform divided by the RMS value of the waveform. High peak-to-average-power ratio (PAPR) has been cited as one of the drawbacks of OFDM modulation format The transmitted time-domain waveform for one OFDM symbol can be written as

$$s(t) = \sum_{k=1}^{N_{sc}} c_k \, e^{j2\pi f_k t} , \qquad f_k = \frac{k-1}{T_s}$$

The PAPR of the OFDM signal is defined as

$$PAPR = \frac{\max\{|s(t)|^2\}}{E\{|s(t)|^2\}} , \qquad t\epsilon[0, T_s]$$

3.1 CCDF:

A better way to characterize the PAPR is to use complementary cumulative distribution function(CCDF) of PAPR , Pc ,which is expressed as

Pc=Pr {PAPR > p}

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. The CDF of the amplitude of a signal sample is given by the CCDF of the PAPR of the data block is desired is our case to compare outputs of various reduction techniques.

IV. PAPR Reduction Techniques

There are many techniques to reduce PAPR.These techniques are divided into two groups – Signal scrambling techniques and signal distortion techniques.

4.1 Signal scrambling techniques :-

- Block coding techniques
- Selective mapping (SLM)
- Partial transmit Sequence (PTS)
- Interleaving technique

- Tone reservation
- Tone Injection

4.2 Signal Distortion techniques
- Peak windowing
- Peak reduction Carrier
- Clipping and filtering
- Envelope Scaling

Most easiest approach is clipping and filtering, but these have non linear distortion.Two scrambling techniques can be used to overcome these problems.Here SLM technique is used in this paper to reduce PAPR of coded OFDM signal which is found best technique among these techniques

V. Channel coding in OFDM for PAPR reduction

OFDM has recently received increased attention due to its capability of supporting high data rate communication in frequency selective fading environments which cause inter symbol Interference (ISI). Instead of using a complicated equalizer as in the conventional single carrier systems, the ISI in OFDM can be eliminated by adding a guard interval which significantly simplifies the receiver structure. However, in order to take advantage of the diversity provided by the multi-path fading, appropriate frequency interleaving and coding is necessary. Therefore, coding becomes an inseparable part in most OFDM applications and a considerable amount of research has focused on optimum encoder, decoder, and interleave design for information transmission via OFDM over fading environments.

VI. PAPR issue of Pre coding Schemes

High PAPR results in signal distortion and degraded performance when the PA linear range is not large enough. Thus, in order to achieve a better performance, the PAPR issue should be considered in the design of signal constellation and pre coding schemes. Moreover, unlike some PAPR reduction methods which require certain parameters to be fed forward from the transmitter to the receiver, this solution does not need such side information and additional forward channel bandwidth. With these advantages, the proposed method can simply become an add-on component to any existing pre coding schemes.

6.1 Encoded OFDM:

The Main objective is to reduce the analyze and reduce the PAPR ratio using SLM Transform Based precoding approach. More over to this comparative analysis of this approach is presented here with standard Coded OFDM and the SLM approach of PAPR reduction. In this scheme we would sense the signals from various subcarriers in parallel The presented work is about to perform the PAPR reduction using SLM technique under Pre-Encoded Channel. The encoding is performed under three main approaches called : Hamming Encoding, RS Encoding and Convolution Encoding. The comparative analysis is performed been the PAPR reduction of Coded-OFDM using SLM approach. The comparision is also performed of SLM approach for OFDM and Coded OFDM. The encoded OFDM is shown in figure 2

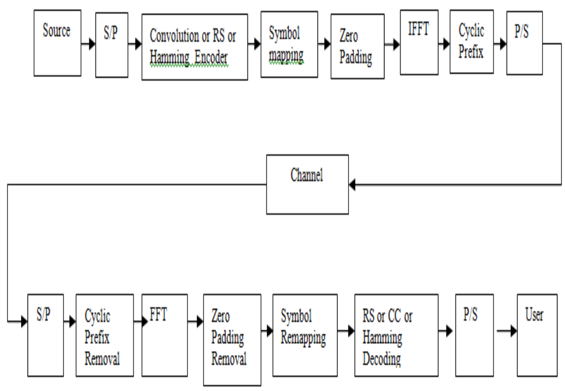

Fig 2 Encoded OFDM

The basic methodologies will be used in the work are :

6.1.1 Reed Solomon Codes

Reed Solomon codes are Maximum Distance Separable (MDS)codes, which means they achieve the maximum possible, minimum distance (dmin) for the forward error correction codes (FEC) with the specified parameters (n, k)Reed Solomon codes are "almost perfect" in the sense that the redundancy added by the encoder is at a minimum for any level of error correction. RS codes allow the correction of erasures, its block decoders are fast and powerful, which can operate at rates. Reed–Solomon coding is very widely used in mass storage systems to correct the burst errors associated with media defects.

6.1.2 Convolution Code

Convolution code is a run(length type code where k input data bits leads to n bits of output codeword bits, k & n are very small (usually k=1(3, n=2(6), Input depends not only on current set of k input bits, but also on past input bits [3], [6]. The number of bits which affect current output code is called constraint length and denoted by K.
Where K= code memory + k

6.1.3 Hamming Code

The Hamming Encoder block creates a Hamming code with message length *K* and codeword length *N*. The number *N* must have the form 2M -1, where *M* is an integer greater than or equal to 3. Then *K* equals *N-M*. This block accepts a column vector input signal of length *K*. The output signal is a column vector of length *N*. The coding scheme uses elements of the finite field GF(2M).

VII. SLM Technique:

Selective Mapping (SLM) is used for minimization of peak to average transmit power of multicarrier transmission system with selected mapping. A complete set of candidate signal is generated signifying the same information in selected mapping, and then concerning the most favorable signal is selected as consider to PAPR and transmitted. In the SLM, the input data structure is multiplied by random series and resultant series with the lowest PAPR is chosen for transmission. To allow the receiver to recover the original data to the multiplying sequence can be sent as 'side information'.

The CCDF of the original signal sequence PAPR above threshold PAPR0 is written as Pr{ PAPR > PAPR0 }. Thus for K statistical independent signal waveforms, CCDF can be written as $[\Pr\{ PAPR > PAPR0 \}]^R$ so the probability of PAPR exceed the same threshold. The probability of PAPR larger than a threshold Z can be written as

$$P(PAPR<Z) = F(Z)^N = (1 - \exp(-Z))^N$$

In selection mapping method, firstly M statistically independent sequences which represent the same information are generated, and next, the resulting M statistically independent data blocks

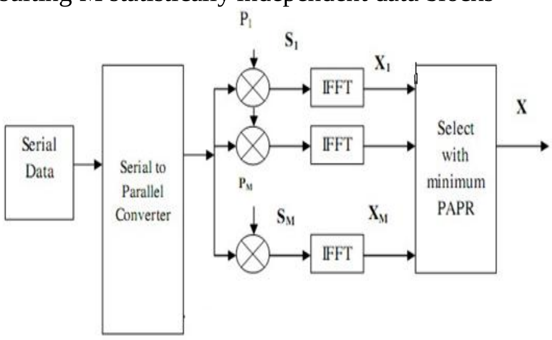

Fig 3 Selective Mapping Technique

VIII. Simulation Results

Simulation process is done in four steps.Simulation steps used are summarized below.

8.1 Simulation steps:

- Generate the Signal
- Encode the Signal
- PAPR Reduction Approach
- Analyze the Signal

8.2 PAPR Reduction using Hamming code:

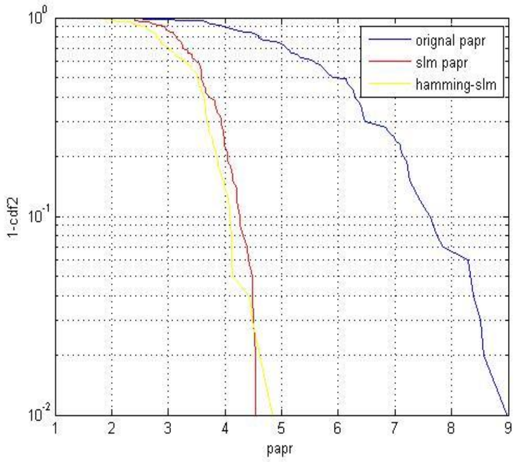

Fig. 4 (Between Complementary cumulative Distribution Function and PAPR)

8.3 PAPR Reduction using RSC code:

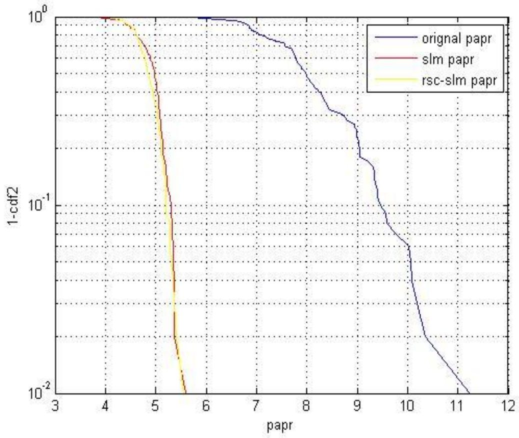

Fig. 5 (Between Complementary cumulative Distribution Function and PAPR)

8.4 PAPR Reduction using Convolution code:

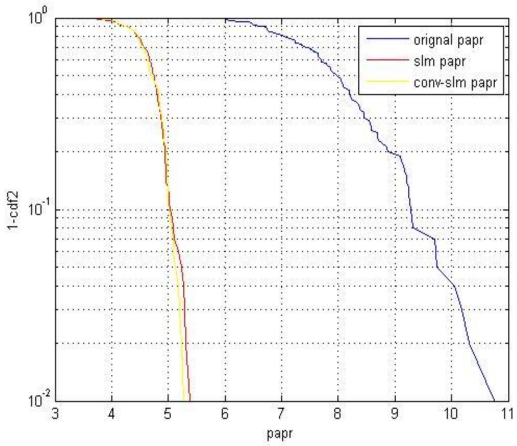

Fig. 6 (Between Complementary cumulative Distribution Function and PAPR)

8.5 Comparison of Hamming code , Convolution code, RSC code:

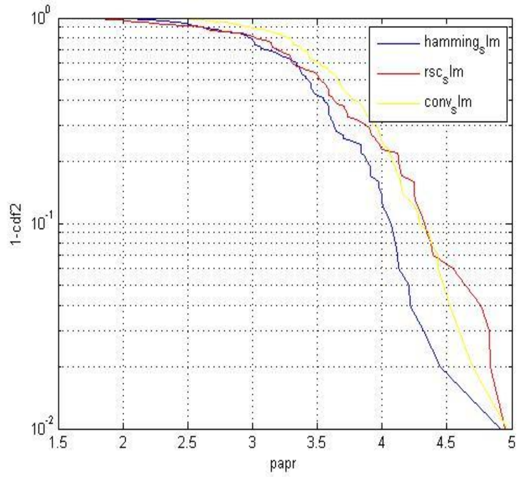

Fig. 76 (Between Complementary cumulative Distribution Function and PAPR)

Here figure showing the result analysis of PAPR reduction under different Encoding Schemes with SLM reduction. Here we have compared using SLM technique Hamming Coded OFDM, RS Encoded and Convolution Encoded OFDM with PAPR Reduction. As we can see the reduction rate of PAPR reduction in Hamming Coded OFDM is higher. The modulation Type is QPSK and its taken for N=16.

IX. Conclusion

A OFDM channel is having number of problems in it including synchronization, PAPR ratio, phase noise etc. PAPR is one of the major problem in OFDM that occur when multiple carrier collectively define a larger peak value then the average peak value of a signal. To increase the linearity in the signal and to reduce the error rate. It is required to reduce the PAPR from the signal. In this present work we have implemented a SLM approach for the PAPR reduction under different encoding approaches. The obtained results shows the effectiveness of the work in terms of high PAPR reduction and lesser BER in the system.

References

[1]. Inderjeet Kaur," The Minimum PAPR Code for OFDM Systems", World Academy of Science, Engineering and Technology, ETRI Journal, Volume 28, Number 2, April 2006

[2]. Abdulla A. Abouda," PAPR reduction of OFDM signal using turbo coding and selective mapping", Proceedings of the 6th Nordic Signal Processing Symposium - NORSIG 2004, June 9 - 11, 2004 Espoo, Finland

[3]. Suverna Sengar," Performance improvement in OFDM system by PAPR reduction", Signal & Image Processing:An International Journal (SIPIJ), Vol.3, No.2, April 2012

[4]. Pawan Sharma," Reducing PAPR of OFDM based wireless systems using companding with convolutional codes", International Journal of Distributed and Parallel Systems (IJDPS), Vol.2, No.6, November 2011

[5]. Victor Cuteanu," PAPR reduction of OFDM signals using multiple symbol representations – Clipping hybrid scheme", Proceedings of SPAMIEC 2011, Cluj-Napoca, Romania,

[6]. Emna Hajlaoui," SOCP Approach for reducing PAPR for MIMO-OFDM via tone reservation", International Journal of Distributed and Parallel Systems (IJDPS), Vol.2, No.3, May 2011

[7]. Klaus Hueske," Ov-OFDM: A Reduced PAPR and Cyclic Prefix Free Multicarrier Transmission System", nformation Theory, 2004. ISIT 2004. Proceedings. International Symposium on Date of Conference: 27 June-2 July 2004

[8]. Kazuki TAKEDA," A PAPR Reduction Scheme Without Side Information For OFDM Signal Transmissions", The 6th IEEE VTS Asia Pacific Wireless Communications Symposium (APWCS2009), Ewha Womans University, Seoul, Korea, 20-21 Aug. 2009

[9]. Malhar Chauhan," Different Techniques to Reduce the PAPR in OFDM System", International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622, Vol. 2, Issue 3, May-Jun 2012, pp.1292-1294

[10]. Dae-Woon Lim," A New PTS OFDM Scheme with Low Complexity for PAPR Reduction", IE IEEE Transaction on Broadcasting, VOL. 52, NO. 1, March 2006

[11]. H. Y. Sakran," An efficient technique for reducing PAPR of OFDM systems in the presence of nonlinear high power amplifier", Progress In Electromagnetics Research C, Vol. 2, 233–241, 2008

[12]. Mohamed H. M. Nerma," On DT-CWT Based OFDM: PAPR Analysis".

[13]. E. Lawrey," PAPR reduction of OFDM signals using peak reduction carriers",Fifth International Symposium on Signal Processing and its Applications, ISSPA '99, Brisbane, Australia, 22-25 August, 1999 Organised by the Signal Processing Research Centre, QUT, Brisbane, Australia

[14]. Pisit Boonsrimuang," PAPR Reduction Method for OFDM Signal by Using Dummy Sub-carriers", World Academy of Science, Engineering and Technology.