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A Novel CMP-SLM Technique to Reduce Peak to Average Power Ratio in MIMO-OFDM

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ABSTRACT This paper proposes a novel CMP-SLM technique, for reduction of peak to average power ratio, in multiple inputs multiple outputs-orthogonal frequency division multiplexing (MIMO-OFDM).This paper analyzed the bit error rate (BER) and peak to average power ratio (PAPR) reduction in OFDM, with AWGN channel and study with different possible quality issues. One of the most important shortcoming issue in OFDM is the high peak-to average power ratio (PAPR).The investigated technique, called Selected Mapping, (SLM) is PAPR reduction techniques for Multiple Inputs Multiple Outputs-Orthogonal Frequency Division Multiplexing (MIMO-OFDM) without affecting the bandwidth capability of the system and the Bit Error Rate (BER) performance. Other investigated technique, called Companding for PAPR reduction in MIMO-OFDM system. This paper proposes Companding selected Mapping technique [CMP-SLM] to reduce the PAPR using Combination of selected-mapping and companding scheme. In this technique, phase multiplication of signal with lower and upper boundary condition, then apply companding and select the minimum PAPR, then transmitted. The proposed scheme reduces 1.6 dB PAPR and bit error rate. This is one of the well-built promising technique for 5-G wireless communication.

KEYWORDS : OFDM, Bit error rate, Selected Mapping and companding, Peak to Average Power Ratio.

I.INTRODUCTION

In recent wireless communication, orthogonal frequency division multiplexing (OFDM) [7,8] has been regarded and used as one of the technologies, for the present high speed communication systems. Wireless communication system is growing speedily in communication industry. Especially OFDM has been adopted for various mobile and wireless communication systems [12] such as wireless local area networks (WLAN) [9], wireless metropolitan area networks (WMAN), digital audio broadcasting (DAB), digital video broadcasting (DVB) [7] , and 4th generation networks. It has high speed data rate, as well as high spectral efficiency. LTE [11] launched as the latest step towards the 4th generation (4G) of radio technologies. OFDM is an attractive technique for completing high data rate (GHz) in the wireless communication systems and it is vigorous to the frequency selective fading channel [5,8]. However, a MIMO-OFDM signal can have very high peak-to average power ratio (PAPR) [9,10] and bit error rate at the transmitter side which occur the high signal misrepresentation such as the in-band distortion and the out-of-band radiation [6,7] due to the nonlinearity of class-C high power amplifier (HPA) [3]. The result occurs is, high power transmitted from transmitter side. This paper organized as follows- Section II -System Model for MIMO-OFDM system. Section III- Describes PAPR reduction. Section IV- Describes PAPR reduction techniques. Section V- Describes Proposed technique. Section VI- Describes simulation results. Section VII- Describes Conclusion.

II. SYSTEM MODEL

1. SISO stands for Single- Input Single- Output. In this communication, single antenna is accessible at transmitter and single at receiver. SISO systems [5,12] are typically less complex than multiple-input multiple-output (MIMO) systems. Frequently, it is also easier to create order of magnitude or trending prediction on the fly or back of the small package. MIMO system have too various communications for most of us to trace through them quickly, thoroughly, and efficiently in our heads.

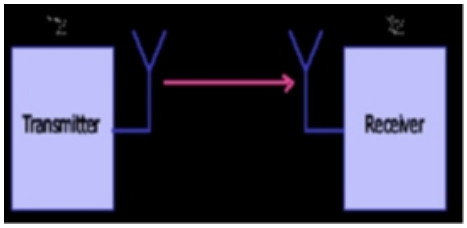

Figure 1 - SISO Model

2. SIMO means for Single Input Multiple Outputs. In this communication, model single antenna is associated at transmitter and multiple at the receiving side. The SIMO is an antenna technology for wireless communications in which various type of antennas are used at the destination or receiver. The antennas are combined to diminish errors and optimize data speed.

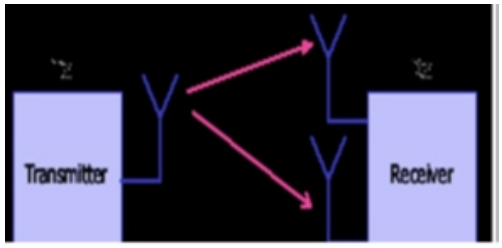

Figure 2 - SIMO Model

3. MISO means for Multiple Input Single Output. In this communication, a number of antennas are connected at transmitter and lone at the receiver. MISO (multiple inputs single output) is the antenna technology for wireless communications system, in which various antennas are used at the source (transmitter). The antennas are combined to decrease errors and optimize data speed. The destination (receiver) has only one antenna. MISO is one of several forms of elegant antenna technology, the others being MIMO (multiple input, multiple output) and SIMO [6,12] (single input, multiple outputs).

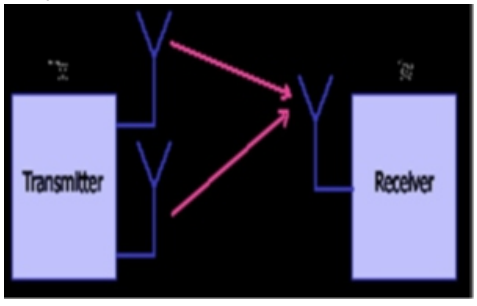

Figure 3 - MISO Model

4. MIMO means for Multiple Input Multiple Output. In this communication, model multiple antennas are at transmitter and several at receiver side both due to which the received signal get

enhancement and this further get betters the throughput of communication model.

In this paper, we consider a MIMO system model to produce OFDM signal successfully, the relationship between all the carriers be obliged to be carefully controlled to preserve the orthogonality of the carriers. OFDM is generated through choosing the spectrum necessary, based on the input data, and modulation scheme used for every carrier to be produced, is assigned the same data to be transmitted. The required magnitude and phase of them are calculated based on the modulation scheme. The essential spectrum is achieved and then converted back to its time domain signal using an Inverse Fast Fourier Transform (IFFT).
The conventional, MIMO-OFDM system [14] -

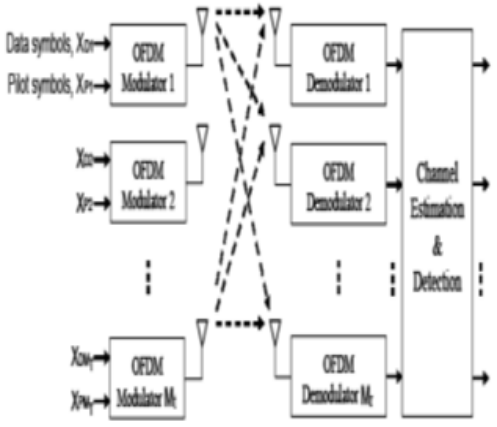

Figure 4 - MIMO-OFDM model

There are mainly two types of MIMO system [9] -

I. Space Time Transmit Diversity :- In this, same data is coded and transmitted through dissimilar antenna which is effectively two times the power in the channel. This improves Signal to Noise (S/N) ratio for cell edge performance.

II. Spatial Multiplexing :- Spatial Multiplexing produces parallel stream of data to CPE, by exploit multipath. It can double MIMO capacity and throughput. SM gives higher capacity ,when RF conditions are favourable and user is closer to the BTS.

III. PEAK TO AVERAGE POWER RATIO REDUCTION

Multiple Inputs Multiple Outputs-Orthogonal Frequency Division Multiplexing (MIMO-OFDM) system, suffers from thoughtful problem of high PAPR, which ascends as a outcome of coherent addition of multiple sub-carriers, amplitude and phase from the system. A Large PAPR restricts the range of Linear Operation of Power amplifier in transmitter. This reduces the transmission efficiency of the system, which is serious problem in communication system. Let us consider the data block of length N to be represented by direction, over time interval [0,τ]. The OFDM symbol can be written as -

$$\mathbf{x}(t) = \sum_{k=0}^{N-1} X_k e^{j 2\pi k f_0 t}$$

where fo=1/T
$PAPR\{X(t)\} = \max.|x(t)|^2 / avg[x(t)]^2$

Where, $\max.[x(t)]^2$ = peak signal power,
$avg\,[x(t)]^2$ = average signal power,
$E|.|$ = Expectation Operator.

Our goal is to reduce peak of PAPR.

IV. PAPR REDUCTION TECHNIQUES

Various techniques for PAPR reduction are as follows -

- Partial Transmit Sequence (PTS)
- Peak Windowing (PW)
- Tone Reservation (TS)
- Clipping Peak (CP)
- Envelope sealing (ES)
- Precoder and Companding (PC)
- Selected mapping (SLM)

Selective Mapping (SLM)
The main objective of this technique is to generate a sequence of data blocks at the transmitter end, which represents the original information and then to choose the most favourable block among them for transmission. Selective Mapping is talented technique to diminish PAPR in MIMO-OFDM system. Fundamental idea behind this scheme is phase rotation of signal and chooses minimum PAPR. In SLM, Signal with low PAPR is selected from different self-governing phase sequences that have identical information at the transmitter [5].

Precoding Technique (PT)
In Precoding technique, first the information source generates random data. The generated random data is modulated by modulation techniques such as BPSK, QPSK, QAM etc. This modulated data is passed through Precoder. In PT, Unitary precoding matrix is taken for coding. Modulated data is multiplied by unitary precoding matrix, then the signal properties changes according to the precoding matrix and performs Space Time Block Code and get precoding output vector and then performs IFFT operation. Finally, this processed signal is transmitted using transmitting antennas. This reduces the probability of occurrence of errors at receiver side, improves Bit Error Rate (BER) performances and provides high data rate.

Companding Technique (CT)
Companding technique is used to decrease the dynamic range and high peak-to-average power ratio of the signal, in order to prevent it from distortion caused by channel. Mu-Law companding technique utilizes Mu-Law algorithm by compressing the peak signals and expanding the small signals for reducing PAPR. This processed signal is transmitted using transmitting antennas.

III. PROPOSED TECHNIQUE

Companding-Selective Mapping (CMP-SLM) is novel technique to diminish PAPR in multiple inputs multiple outputs-orthogonal frequency division multiplexing (MIMO-OFDM) system. Companding- selected mapping technique is to reduce the PAPR, using combination of Selected mapping and Companding scheme .This paper proposes Companding-selected Mapping technique to reduce the PAPR using Combination of selected mapping and companding scheme. In this technique, phase multiplication of signal with lower and upper boundary condition, then apply companding and select minimum PAPR, and then transmitted. The proposed scheme reduces a 1.67 dB PAPR and bit error rate. The consequence of all this analysis is that a CMP-SLM system has to test phase sequences until a signal with a PAPR<γo is found. It is possible that further phase mappings could produce an even lower PAPR of the signal but just established that any further PAPR reduction will not further improve the power efficiency for a given Power Amplifier with a fixed bias.

IV. SIMULATION RESULT

In this section, all the simulation done on MATLAB platform. This simulation has been conducted to evaluate the ability of the proposed scheme including the Peak to Average Power Ratio (PAPR) reduction and the Bit error Rate (BER) performance, where data blocks are generated with 128 consider the oversampling factor 8. The phases factors are chosen from Quadrature Phase Shift Keying (QPSK) modulation are employed.

Showing simulation result in table 1.1 as -

Number of transmitted symbol	128
PAPR of SLM in(dB)	7.23
PAPR of CMP-SLM in(dB)	5.56

Table 1.1- PAPR (dB) values of OFDM system for different Number of transmitted symbol

This table shows the PAPR (in dB) values of MIMO-OFDM system and Companding-Selected Mapping for 128 Number of transmitted symbol, which is reducing PAPR from 7.23 dB to 5.56 dB by using Companding Selected Mapping technique.

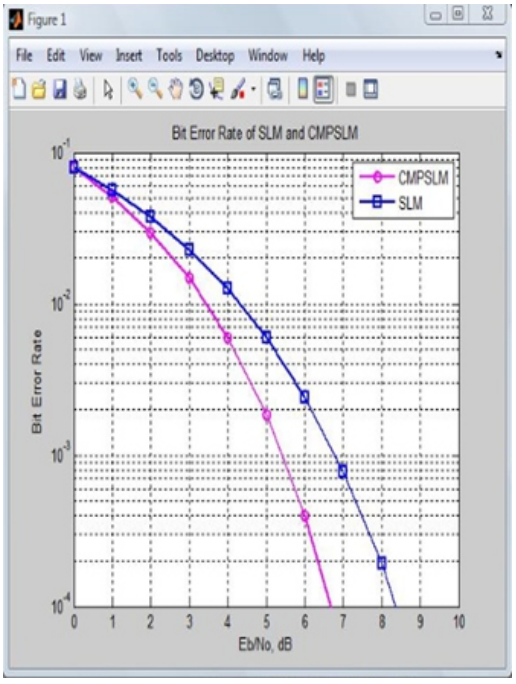

Figure 5 - BER Performance of SLM and CMPSLM

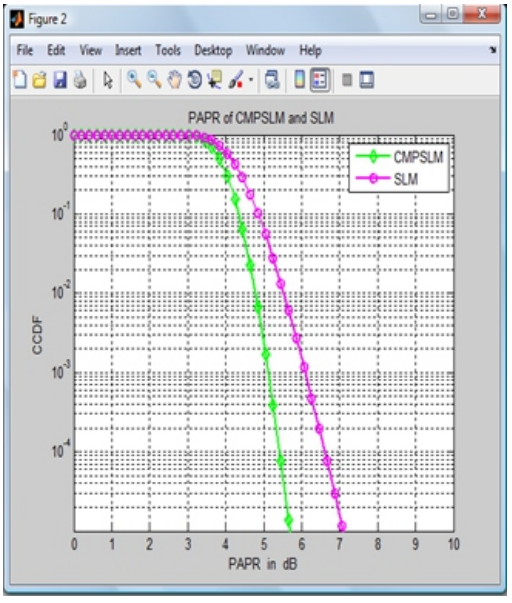

Figure 6 - PAPR Performance of SLM and CMPSLM

VII. CONCLUSION

This paper describes the Multicarrier systems are proving better in transmission than single carrier systems. MIMO-OFDM is a digital multi-carrier modulation method where a great number of closely spread out orthogonal sub- carriers are used, to carry data. One of the major weaknesses of MIMO-OFDM system, is that the complex transmit signal can display a very high PAPR, when the input sequences are highly associated.We proposes Companding-selected Mapping technique to reduce the PAPR using Combination of selected mapping and companding scheme .In this, phase multiplication of signal with boundary condition and apply companding then select minimum PAPR and transmitted. The proposed scheme reduces a 1.67 dB PAPR and increase performance of Bit Error Rate.

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