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PAPR Reduction of OFDM Using Modified Selective Mapping and Clipping Technique

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Abstract:-orthogonal frequency division multiplexing (OFDM) is multicarrier technique for high data transmission rate commonly used in 4G communication these days also used in digital video broadcasting (DVB) and many more application when ever high data transmission rate is required. The main problem of OFDM is high Peak-to-average power ratio because OFDM is highly sensitive to non-linear region of high power amplifier. Many more technique has been proposed and implemented to reduce Peak to Average power ratio and bring PAPR to desired level. Most commonly used techniques are partial transmitted sequence, selective mapping, clipping, tone injection and many more. This paper will deal about reduction in Peak- to-average power ratio using modified selective mapping (SLM) and clipping technique to ensure that OFDM system performance is improved.

Index term: - Modified SLM (selective mapping), clipping, bit-error-rate, OFDM

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I. INTRODUCTION: -

With the ever developing demand of communication technologies, need for excessive speed conversation has end up an utmost priority. Numerous multicarrier modulation strategies have advanced with a view to meet these needs, few exquisite amongst them being Code division multiple get entry to (CDMA) and Orthogonal Frequency division Multiplexing (OFDM). Orthogonal Frequency division Multiplexing is a frequency – division multiplexing (FDM) scheme utilized as a digital multi – carrier modulation method. A big number of intently spaced orthogonal sub – carrier is used to carry data. The data is split into several parallel streams of channels, one for every sub – carriers. every sub – carrier is modulated with a conventional modulation scheme (along with QPSK) at a low symbol rate, preserving overall data rate much like the traditional single carrier modulation schemes in the equal bandwidth. Along with several advantages there are many disadvantages of multicarrier technique like inter symbol interference and inter channel interference that has been removed in OFDM by implementing orthogonal carrier and cyclic prefix respectively. But one more drawback of OFDM is high PAPR and due to high PAPR high power amplifier works in non linear region hence the performance of the OFDM system is degraded.

In order to improve the efficiency of HPA literature number of high PAPR reduction technique has been proposed. Techniques have been classified in two categories (I) With Distortion technique (ii) Distortion-less technique. Partial transmitted sequence and selective mapping are the distortion less techniques where as clipping and COMPANDING are with distortion techniques. This paper is subdivided in four sections 1.Basic of OFDM and PAPR 2.Selective Mapping technique and Clipping technique 3. Proposed work 4.Conclusion

II. Basic of OFDM and PAPR

As we know OFDM is multicarrier technique the basic principle of OFDM is to divide single frequency selective fading to parallel flat fading channels. First have to set structure of constellation (example 4 for QPSK, 16 for 16psk etc) with number of data points 128 taken in this paper. Moving towards processes of OFDM we have to generate a random serial sequence of 1x128 followed by QPSK modulation. QPSK modulated data is converted by serial to parallel converter to add cyclic prefix (to avoid inter-symbol interference) followed by IFFT. After IFFT we have discrete time domain signal that is given by

$$x(n) = \frac{1}{\sqrt{N}} \sum_{k=0}^{N-1} X_k e^{\frac{j2\pi n}{N}}$$

…….(1)

Where n=0, 1, 2, 3 ……..N-1. N is the number of subcarriers and X_k is the Kth QPSK modulated data. As we have N subcarriers hence we have N modulated symbols those are summed up to give one time domain of OFDM signal as a consequence at some instance some instantaneous power value is more large compare to average power value of OFDM signal and can be written as

$$PAPR = \frac{\max |x(t)|^2}{E[|x(t)|^2]}$$

.....(2)

$$\text{PAPR[x(n)]} = 10\log\frac{\max[|x(n)|^2]}{E[|x(n)|^2]}$$

.....(3)

Where $E[..]$denotes expectation operator. For sufficient N magnitude of OFDM samples follows Rayleigh distribution. Hence, statistically the PAPR of an OFDM signal expressed in terms of probability of exceeding some threshold value Complementary cumulative distribution function (CCDF) of PAPR is given by

$$P(y > y_o) = 1 - P(y \leq y_o)$$
$$P(y > y_o) = 1 - R(y_o)^N$$
$$P(y > y_o) = 1 - (1 - e^{-y})^N$$

.....(4)

Where Y denotes PAPR of OFDM symbols and y_o denotes threshold value of PAPR symbols and R represents Rayleigh distribution. Equation number 1, 2, 3and 4 has been referred from reference paper (v)

III. Selective mapping technique and clipping technique

Conventional selective mapping (SLM) is a method for PAPR reduction was first time introduced in [vi]. In SLM method B statistically independent alternative OFDM symbols are generated from the same OFDM symbol. These alternative OFDM symbols are generated by multiplying the N modulated data symbols with B different phase vectors component wise and then input to the B IFFT blocks of block size N. Finally an alternative OFDM symbol which has lowest PAPR is selected and then transmitted. Alternative OFDM signals are generated by the inverse fast Fourier transform and can be written as

$$x^b = IFFT(X^b) \quad 1 < b < B$$

.....(5)

Equation no 5 has been referred from reference paper(i)

At the SLM-block OFDM has lowest PAPR is selected from x^b alternative signal and transmitted. Fundamentals of this technique is to select the signal from x^b OFDM signal that has lowest PAPR the process can be performed by generating OFDM signal that has lowest correlation as possible. For this phase sequence of element that generate OFDM signal must be less correlated. If sequence of the OFDM signal is periodic alternative sequence is aperiodic. So it is very important to select phase sequence that must be less correlated. Phase sequence vector are generated randomly from $(\pm 1, \pm j)$ having less correlation properties. As we have taken QPSK modulation technique hence the phase sequence could be (-1-j,-1+j,1-j,1+j). If hadamard matrix is taken as phase sequence set then PAPR is high even if the sequence is orthogonal because rows of that matrix are highly correlated. If Riemann matrix is taken as phase sequence then we can get improved PAPR because rows are less correlated. Because of some element having large magnitude hence average power is high this will reduce the value of PAPR but improvement results in loss of battery life in case of mobile communication.

Clipping technique:-clipping method is a method of distortion technique method is performing with the concept of removing unwanted peak appears due to correlated symbols. Concept is removing peaks means cuts the signal portion hence this will distort the signal that's why it comes under distortion technique. Due to this is a distortion technique hence the signal distortion and bit-error-rate may increase but the peak of OFDM signal once the maximum peak of ODFM get reduce this will reduce the Peak to Average Power ratio. The basic mechanism of this technique is to replace the peak of OFDM by average value of the OFDM signal if value of peak is either greater than positive average value of peak or less than negative value of peak. After this we got clipped OFDM signal with reduced PAPR due to this clipping technique with distorted signal bit-error-rate may increase but peak to average power ratio will decreases and the main concentration of this paper is to reduce PAPR .

IV. PROPOSED Method

The basic parameter of this paper is to reduce PAPR for functioning same we are going to implement the selective mapping with the concept of clipping. OFDM signal is a time domain signal received from IFFT block showing characteristics of high peak to average power ratio due to correlation between OFDM symbols. Figure1 shows the proposed method that is modified selective mapping with clipping.

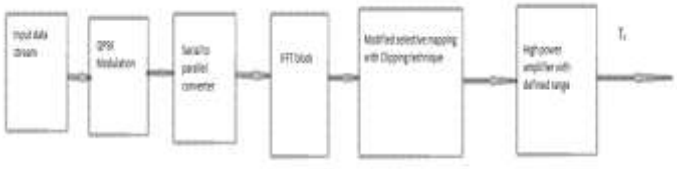

Figure1-Proposed Method

We are just clipping this high peak to remove PAPR problem by replacing the peak by average value. This concept of clipping of OFDM signal can also be applicable to selective mapping for clipping the signal that have more high peak to average power ratio and least probability of finding OFDM symbols and having PAPR of 6db and greater. Figure2 shows that probability verses PAPR graph here we can see that there are less number of symbols having more PAPR near about 6db

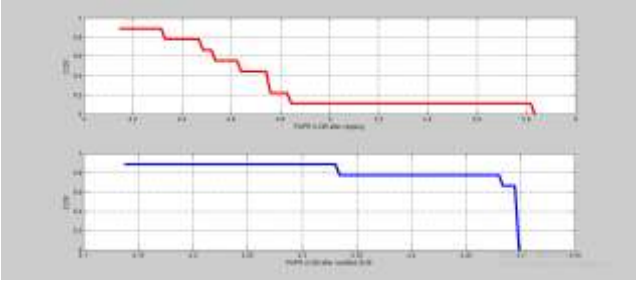

Figure2-PAPR verses probability of the symbols

This proposed method will clip the signal whose value is greater than 5db or 4db it can be set to an arbitrary value depending upon the requirement of application. The graph is actually showing the PAPR is 6db after clipping the signal means high power amplifier have to handle minimum PAPR of 6db suppose that we have a high power amplifier that cannot handle the minimum PAPR of 6db then whole information get distorted. Here we can implement our proposed method to limit the PAPR value let the high power can handle PAPR value of 5db or 4 db by this method we can use that information with little bit-error –rate. By the property of selective mapping SLM selector selects the signal whose value is less then 4db or 5db and clip the high PAPR value signal as shown in result figure. We can see that least symbol having high PAPR value so we can clipped the signal of high PAPR value like this way we can get the low PAPR value of less bit-error rate.

V. CONCLUSION

By this clipped selective mapping technique we can easily handle with the high PAPR problem in limited range of high power amplifier. It can be proved very useful in low range application. In this paper I had used 128 point IFFT this can be applied to many more as per requirement. As we used selective mapping in distortion method hence increment in bit-error-rate may occurs. More future work can be done on improvement on bit-error-rate.

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