DCT SLM Scheme for Peak-To-Average Power Ratio Reduction in OFCDM System Review

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ABSTRACT
We introduce DCT SLM orthogonal frequency coded division multiplexing (OFCDM) scheme for reduction of peak to average power ratio. There is a time for high-speed data transmission in mobile communications.OFCDM is very promising technique for 4G standard like LTE (Long Term Evolution) and WIMAX (Worldwide Inter-operability for Microwave Access) but also has some issues like frequency-offset and PAPR (peak-to-average power ratio). High peak-to-average power ratio (PAPR) of the transmitted signal originates from the superposition of many independent subcarriers.In this paper, a Discrete Cosine Transform based modified selective mapping technique is proposed to reduce the PAPR of the transmitted signal. This method combines Discrete Cosine Transform (DCT) with modified Selective Level Mapping (SLM), the variant of SLM make use of the standard array of linear block codes. The proposed method can be realized in two ways- scheme 1 and 2. In scheme1 DCT is used before the IFFT block in Modified SLM and in scheme 2 DCT is used after the Modified SLM block. Simulation results shows that Scheme 1 is having better reduction performance than the scheme 2. Due to PAPR reduction ICI and ISI both reduces drastically.

Keywords
DCT, DCT SLM, Modified SLM, PAPR, SLM

1. INTRODUCTION
Future 4G systems need transmission of richer multimedia services which certainly imply an increase in data rate. The 4G systems will support multimedia services like high-speed Internet access and broadcast services from information sites.OFCDM is a multicarrier transmission scheme where user data is spread in time and frequency direction before it is transmitted on multiple sub-carriers using OFDM transmission Orthogonal frequency and code division multiplexing is a very attractive technique for high speed data transmission in mobile communications due to various advantages such as high spectral efficiency, robustness to channel fading, immunity to impulse interference, and capability of handling very strong multi-path fading and frequency selective fading without having to provide powerful channel equalization

1.1 OFCDM
Combining OFDM with two-dimensional spreading (time and frequency domain spreading), an orthogonal frequency and code-division multiplexing (OFCDM) system has been proposed for the downlink communication in future 4G networks. Based on OFDM, OFCDM provides not only all advantages of OFDM, but also extra benefits by means of 2D spreading. For example, frequency diversity gain can be achieved through frequency domain de-spreading due to the different fading experienced by subcarriers in a broadband channel. Furthermore, with the introduction of time domain spreading, the system can provide flexible broadcasting rates. Similar to OFDM, OFCDM readily supports MIMO antenna techniques.

1.2 PAPR (Peak-To-Average Power Ratio)
The PAPR is the relation between the maximum power of a sample in a given OFCDM broadcast symbol divided by the average power of that OFCDM symbol. PAPR occurs in a multicarrier system when the different sub-carriers are out of phase with each other. The input symbol stream of the IFFT should have a uniform power spectrum, but the output of the IFFT may result in a non uniform or pointed power spectrum. Most of transmission energy would be allocated for a few instead of the majority subcarriers. This problem can be quantified as the PAPR measure. It causes lots of problems in the OFCDM system at the transmitting end. Also transistor work as an amplifier in linear mode but when peak deviation about average is significantly high and the signal level moves into non linear region, an amplifier output gets distorted and we will not get faithful amplification. Hence high value of PAPR in OFCDM system results in, amplifier goes in non-linear region. Thus OFCDM losses its orthogonality which leads to Inter Carrier Interference(ICI) in the system and inter symbol interference(ISI) that is more severe than due to pre symbol interference of OFCDM.PAPR is problematic because there is no such amplifiers or digital to analog converters (DAC / ADC) which have wide range of linearity. so due to limitation of linearity of amplifiers and converters, one way to combat PAPR is power back - off, in which if power exceeds to linearity range of amplifiers /converters then it back - off by limiter circuit & maintain it in linear range of the device . Another way to reduce PAPR is to increase the linearity range of amplifiers / converters but it is very rigorous to design & very costly too.

2. OVERALL ANALYSIS REPORTED WORK
At present a sub career processing (SCP) technique have been used to reduce PAPR by more than 5 dB. In OFCDM a Partial Transmit Sequence (PR-PTS) technique has been used for the reduction of PMEPR and its performance has been evaluated with pseudo-random Selective Mapping (PR-SLM). So, based on their analyses it is found that PR-PTS has the ability to reduce PMEPR for OFCDM by up to 60% (11 dB), which is quite a significant decrease. This helps to

improve the strict requirements on the DAC and the HPA. Thus, we will use other technique to further reduce PAPR ratio in OFCDM.

[1] Author has presented an efficient method to reduce the PAPR of the OFDM signal. The new model combines the features of DCT SLM as well as that of modified SLM to further reduce PAPR of the signal than they perform individually. The proposed method has been realized in two ways- scheme 1 and 2. In scheme1 DCT is used before the IFFT block in Modified SLM and in scheme 2 DCT is used after the Modified SLM block. Simulation results shows that Scheme 1 is having better reduction performance than the scheme 2. The result shows that in DCT SLM with 8 blocks representing the same information, the PAPR got reduced to 6 db, reducing almost 5.8 db from the normal OFDM system which can be improved further by increasing the number of blocks that represents the same information, which increases the complexity of the architecture.

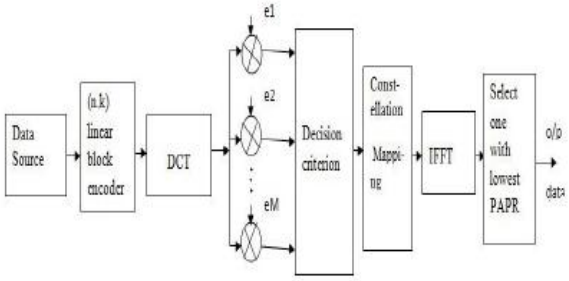

Fig 1: DCT Before Modified SLM Technique.

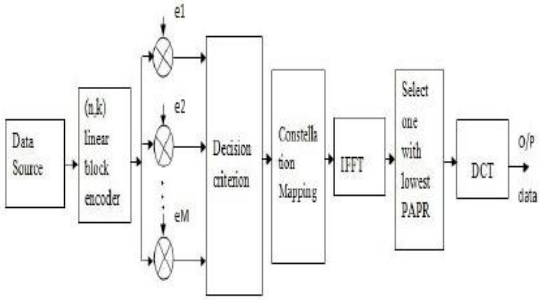

Fig 2: DCT After Modified SLM Technique.

[2] In this paper author have shown that OFCDM has different PMEPR characteristics than OFDM and in fact the PMEPR for OFCDM is much greater than that for OFDM. Appreciating the need of reducing the PMEPR for OFCDM, they examine the PMEPR reduction capabilities of SLM and PTS and propose a solution to the problem. They also shown that only a special type of SLM and PTS provide consistent PMEPR reduction for OFCDM. Two techniques to reduce the PMEPR i.e. SLM and PTS were tested with a number of configurations and their performance was compared. Based on their analyses and observations, it was found that adjacent and interleaved segmentation methods for PTS do not provide a guaranteed reduction in PMEPR even when the number of segments is increased. Meanwhile, the use of PR-PTS led to a significant reduction in PMEPR. In fact, the performance of PR-PTS with OFCDM is identical to that of PR-PTS with OFDM. The use of SLM, where phase sequences were generated in a random manner, also led to significant reduction of PMEPR; however, PR-PTS performed slightly better than SLM. On the basis of these observations, PR-PTS has been proposed for the PMEPR reduction of OFCDM.

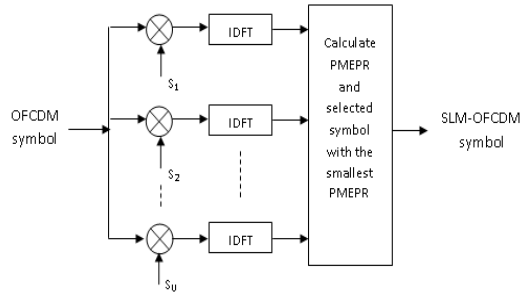

Fig 3: Block diagram of Selective Mapping (SLM).

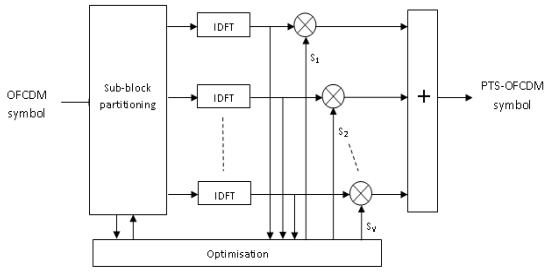

Fig 4: Block diagram of Partial Transmit Sequence (PTS).

[3]In this paper they proposed a sub career processing (SCP) technique for reduction of PAPR which is mainly depend on FFT operation followed by sub carrier mapping. As in OFCDM each data is carried by individual subcarrier but in this method many sub-carrier carry the same data since mapped data is less as compared to number of sub-carrier. Sub carrier mapping plays important role in reduction of PAPR & it is also shown that distributed mapping is much more effective than localized mapping Thus by the simulation result it is shown that the proposed technique is very efficient & PAPR reduces up to 8 dB without adding any complication in the system. So SCP technique is simple and effective technique.

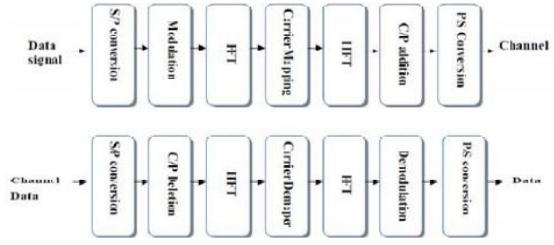

Fig 5: SCP Transmitter and Receiver.

[4] In this paper, authors suggest a Discrete Cosine Transform (DCT) precoding based SLM technique for PAPR reduction in OFDM systems. This technique is based on precoding the constellation symbols with DCT precoder after the multiplication of phase rotation factor and before the Inverse Fast Fourier Transform (IFFT) in SLM-OFDM System. Simulation results show that our proposed technique can reduce the PAPR to about 5.5dB for N=64 and V=16 at clipping probability of 10^{-3}. Also they make the use of DCT based precoder which is less complex than other precoders after the multiplication of phase rotation factor and before the IFFT in the SLM-OFDM system. This technique is signal

independent and it does not require any complex optimization technique. Thus it is efficient, signal independent, distortion-less and does not require any complex optimization.

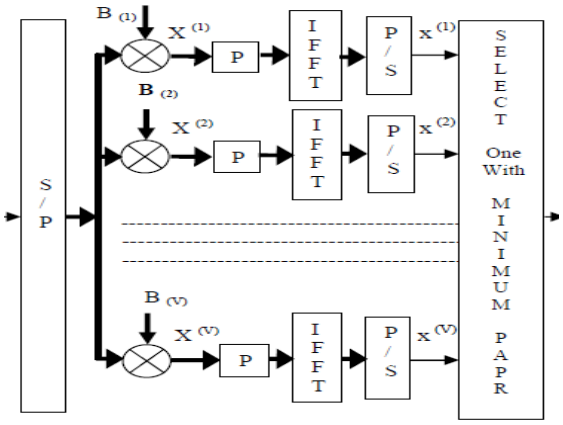

Fig 6: Block Diagram of DCT Precoder based SLM-OFDM System

[5]The authors introduce a new selected mapping (SLM) orthogonal frequency division multiplexing (OFDM) scheme with low computational complexity. The proposed SLM scheme transforms an input symbol sequence into a set of OFDM signals by multiplying the phase sequences to the signal after a certain intermediate stage of inverse fast Fourier transform (IFFT). Then, the OFDM signal with the lowest peak-to-average power ratio (PAPR) is selected for transmission. The new SLM OFDM scheme reduces the computational complexity, while it shows almost the same performance of PAPR reduction as that of the conventional SLM OFDM scheme. The computational complexity reduction ratio increases with number of carriers, which makes the proposed scheme more suitable for the high-data-rate OFDM systems.

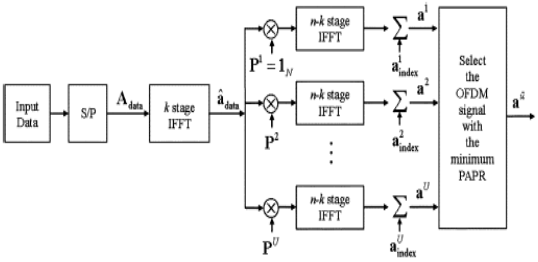

Fig 7: Block diagram of new SLM OFDM Scheme

[6]Author proposed the basic structure and main functions of the OFCDM system. A non sequential code assignment scheme was introduced. The novel detection method for the OFCDM, called hybrid multi code interference cancellation and minimum mean square error detection. High-speed data transmission is needed in future wireless systems, especially in the downlink. OFCDM has become a very attractive wireless access technique for future 4G mobile communications due to its superiority to OFDM. OFCDM technique has shown promising results in achieving a high data rate while simultaneously combating multipath fading. OFCDM is a combination of orthogonal frequency division multiplexing and two-dimensional (2D) spreading. 2D spreading helps to achieve diversity gains in both time and frequency domains. The present OFCDM systems employ 1D orthogonal variable spreading factor (OVSF) codes to achieve the required 2D spreading in code multiplexed channels. However, 2D OVSF codes have better correlation properties in comparison to 1D OVSF codes.

3. PROPOSED METHODOLOGY

The main idea of the proposed scheme is to use a combination of two methods. One is the DCT matrix transform technique and SLM technique.

3.1 DCT-SLM Technique

The idea to use the DCT transform is to reduce the auto-correlation of the input sequence which further reduces the peak to average power problem and it also requires no side information to be transmitted to the receiver. Though SLM system can obtain better PAPR by modifying the OFDM signal without distortion, its complexity is high. DCT SLM is an efficient PAPR reduction technique based on joint SLM and DCT matrix transform is proposed. The main idea of the DCT SLM is to use a combination of two appropriate methods. One is the DCT matrix transform technique and the other is the SLM technique.

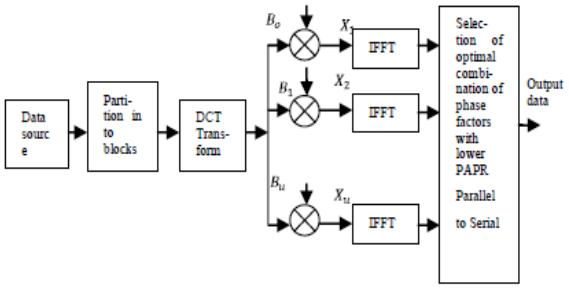

Fig 8: DCT Before SLM Technique.

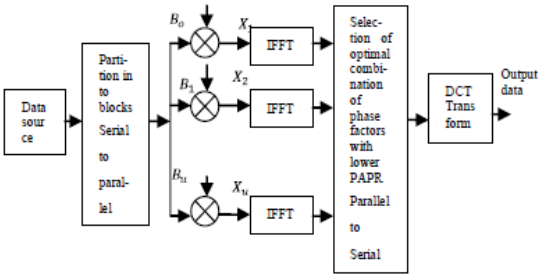

Fig 9: DCT After SLM Technique

4. CONCUSION

Proposed work represents an efficient method to reduce high PAPR of the OFCDM signal. The new model combines the features of DCT matrix transform technique and the other SLM technique to produce further reduction in the PAPR of the signal than they perform individually.

5. REFERENCES

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