Efficient PAPR Mitigation in NC-OFDM System with m-QAM and f-PTS Scheme

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Abstract- Transmitting the sufficient power of a signal is the foremost requirement of an NC-OFDM system. To maintain the power of signal throughout transmission over communication system and it can be achieved by keeping the average power of the signal and it is in terms of peak to average power ratio (PAPR). If PAPR is reduced the performance of the system will improve. In this work an advanced and efficient methodology is used which utilizes filtered-PTS algorithm with difference modulation index of QAM to reduce the PAPR. From the simulated results performed for m=16, 64, 128 to analyze the performance of the proposed approach. Simultaneous analyzing the performance of the system in terms of PAPR.

Keywords - m-QAM, PAPR, f-PTS and CCDF etc.

I. INTRODUCTION

The demand of high data rate services has been increasing very rapidly and there is no slowdown in sight. We know that the data transmission includes both wired and wireless medium. Often, these services require very reliable data transmission over very harsh environment. Most of these transmission systems experience much degradation such as large attenuation, noise, multipath, interference, time variance, nonlinearities and must meet the finite constraints like power limitation and cost factor. One physical layer technique that has gained a lot of popularities due to its robustness in dealing with these impairments is multi-carrier modulation technique. In multi-carrier modulation, the most commonly used technique is Orthogonal Frequency Division Multiplexing (OFDM); it has recently become very popular in wireless communication. The major drawback of OFDM transmission is its large envelope fluctuation which is quantified as Peak to Average Power Ratio (PAPR).

One of the challenges of the OFDM is high peak-to-average power ratio (PAPR). A high PAPR brings disadvantages like an increased complexity of the A/D and D/A converters and reduced efficiency of radio frequency (RF) power amplifier as shown in Fig. 1.1 basic OFDM system block representation. OFDM signal consists of a number of independent modulated subcarriers that leads to the problem of PAPR. If all subcarriers come with same phase, the peak power is N times the average power of the signal where N is the total number of symbols in an OFDM signal. Thus, it is not possible to send this high peak amplitude signals to the transmitter without reducing peaks. Because power amplifier used for the transmission has non-linear nature which causing inter-modulation and out-of-band radiation. The high peak of OFDM signal can be reduced in several ways.

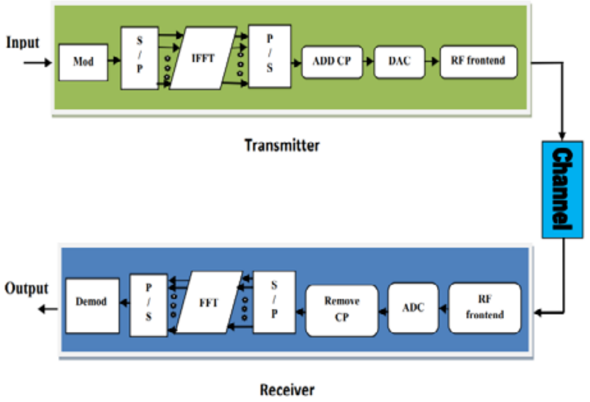

Fig. 1.1 Basic diagram of OFDM Transceiver.

Since power amplifier is used at the transmitter, so as to operate in a perfectly linear region the operating power must lies below the available power. For reduction of this PAPR lot of algorithms have been developed. All of the techniques has some sort of advantages and disadvantages. Clipping and Filtering is one of the basic technique in which some part of transmitted signal undergoes into distortion. Also the Coding scheme reduces the data rate which is undesirable. If we consider Tone Reservation (TR) technique it also allows the data rate loss with more probable of increasing power. Again the techniques like Tone Injection (TI) and the Active Constellation Extension (ACE) having a criteria of increasing power will be undesirable in case of power constraint environment. If we go for the Partial Transmit Sequence (PTS) and Selected Mapping (SLM) technique, the PTS technique has more complexity than that of SLM technique.

The concentration of this examination work is specially upon the f-PTS. Here the three important analysis of this technique has been done. Out of them one is, how to avoid the transmission of extra information along with the OFDM signal which is used to Avoid the SI index Transmission. Another one important analysis of this technique is how to reduce the computational complexity. Also one important analysis is to be done about the mutual independence between the alternative phase vectors used in this technique.

II. NC-OFDM SYSTEM MODEL

In OFDM system, the achievement of large number of non-contiguous subcarriers by collective usage for the high data rate transmission is referred as Non-Contiguous OFDM (NC-OFDM) [31]. NC-OFDM can provide the necessary agile spectrum usage for the target licensed spectrum if spectrum can be occupied by primary and secondary users. The spectrum sensing measurements are deactivated during the subcarriers corresponding to the spectrum occupied by primary user. Moreover, dynamic spectrum sensing can be determined when the active subcarriers are located in the unoccupied spectrum bands.

Fundamentals of the NC-OFDM signal transmission and reception are quite similar to that of the OFDM signal. However, NC-OFDM techniques offer very important advantage for growing scarcity of the large contiguous frequency spectrum, i.e. it can support dynamic spectrum pooling for high data rate transmissions.

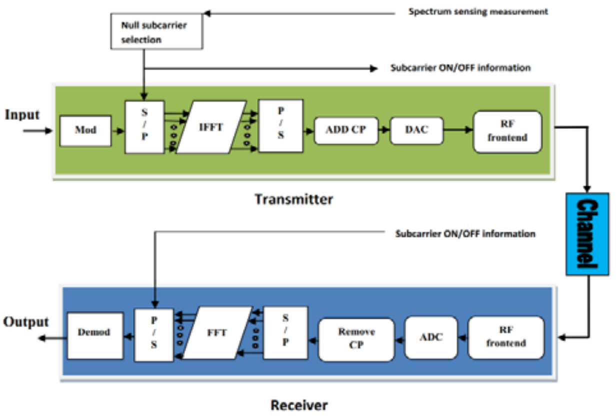

Fig.2.1 NC-OFDM Transceiver.

III. PROPOSED METHODOLOGY

To overcome PAPR in NC-OFDM system F- PTS Scheme with m-QAM modulation has been proposed Implemented and simulated in MATLAB in this work. To get low data rate yield parallel bit stream, the high data rate sequential input bit stream is taken as binary data is faded into serial to parallel converter. A Signal Mapper is empowers to modulated the low data rate parallel bit stream. A QAM modulation with 16, 64, 128 index is used in this examination. The modulated information are treated as input to IFFT. so each subcarrier is relegated with a particular frequency. The frequencies are which are selected are orthogonal frequencies. In this block, orthogonality in subcarriers are introduced. In IFFT, the frequency domain OFDM symbols are converted into time domain OFDM symbols. Fig. 3.1 shows Proposed NC-OFDM System for PAPR Reduction.

The partial transmit sequence requires side data to be sent to the beneficiary to illuminate it of the phase rotation utilized so the information can be decoded. The number of angles should be kept low to keep the side information to a minimum. Explicit side information can be avoided if differential encoding is used for the modulation across the subcarriers within each subblock. In this case only the block partitioning need to be known at the receiver and one subcarrier in each subblock must be left unmodulated as a reference carrier. PTS is adaptable as the quantity of squares and phase rotation can be expanded giving more option transmit signs to look over.

Alternatively the optimization can be performed in an iterative fashion where the current best transit signal is stored until a better one is found, at the cost of increased latency. However issues such as complexity and filtering after PTS limit the techniques usefulness. Increasing the number of phase rotations provides increasingly less PAPR reduction for a set.

PTS produces alternative signals by breaking up the transmit bit stream and phase rotating whole parts before performing the IFFT. The reductions made with PTS are drastically reduced when passed through a pulse shaping filter due to peak re-growth. Peak re-growth after some form of PAPR reduction is more severe than when no PAPR reduction is performed.

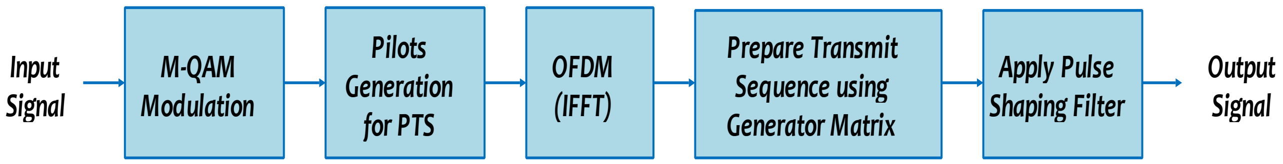

Fig. 3.1 Proposed NC- OFDM System for PAPR Reduction.

Fig. 3.2 shows the flow of algorithm in MATLAB. Initially to start simulation in MATLAB simulation parameters are defined and their initial values are fixed by initialization process. After initialization of simulation parameters PAPR of system has been calculated using PTS scheme and random data signals are generated. A blank variable for PAPR-PTS has defined in MATLAB and random signal is modulated using MQAM modulation. Compute length of signal and pilot randomly distribute signal with pilots. Apply OFDM modulation (IFFT). Generate Transmit sequence using generator matrix and find maximum value. Check Optimum /best partial values. Apply pulse shaping filter and compare different power and its ratios. Categorize PAPR for CCDFs compare and display results.

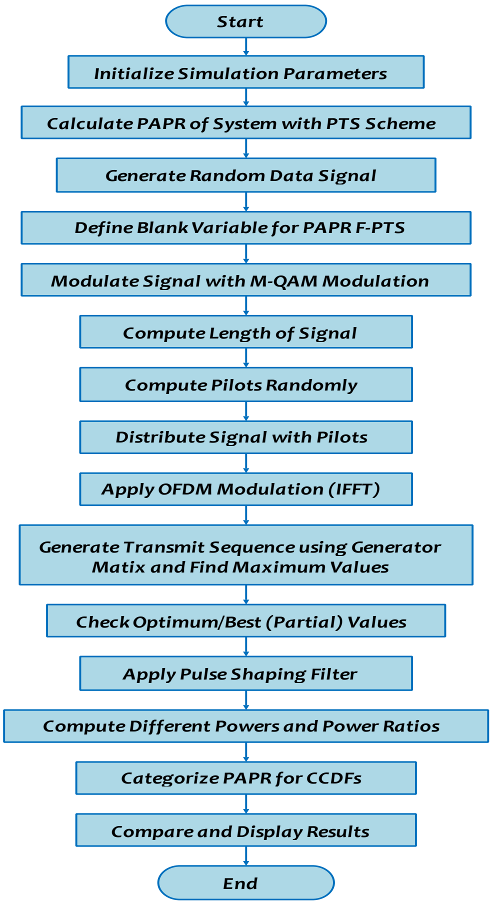

Fig.3.2 Simulation Execution Flow of Proposed Methodology.

IV. SIMULATION RESULTS

The PTS technique partitions the input sequence into several subgroups, called partial transmit sequences. A sign sequence, where each element corresponds to the sign for each subgroup, is used to obtain a suboptimal solution. The effect of pulse shaping filter on PTS and the new techniques F-PTS is proposed, where it was seen that an oversampling factor of 2 was sufficient to bring the discrete PAPR to within 1dB of the filtered PAPR. The effect of oversampling was to increase the PAPR of the discrete CCDF while reducing the CCDF of the filtered CCDF.

The CCDF is the computation of time domain signal power complementary cumulative distribution function. The CCDF curve represented the measure of time spends over the normal power level of the mapped signal, or equivalently, the probability that the signal power will be above the average power level.

$$CCDF = P(PAPR > PAPR_0) = 1 - (1 - \exp(PAPR_0))^N \ldots \ldots . . (1)$$

$$PAPR = 10\,log_{10}\left[\frac{max(x^2(t))}{mean(x^2(t))}\right] \ldots \ldots \ldots \ldots \ldots \ldots . . (2)$$

Where *x(t)* is the amplitude of the signal.

Simulated results are compared to analytical results for previous work and 16, 64,128 QAM NC-OFDM. The difference was squared and stored and then averaged to find the noise variance. The simulation results for 16, 64,128 QAM were found to better fit the analytical results than previous base work, the tails in both cases fall of quicker in the simulated case. However a good agreement is seen between the analytical and simulated curves.

The results are compared the PAR reduction performance of the filter partial sequence method (F-PTS) with that of base work shows the PAR distribution for both methods. It is clear that the F-PTS method can significantly reduce the PAR.

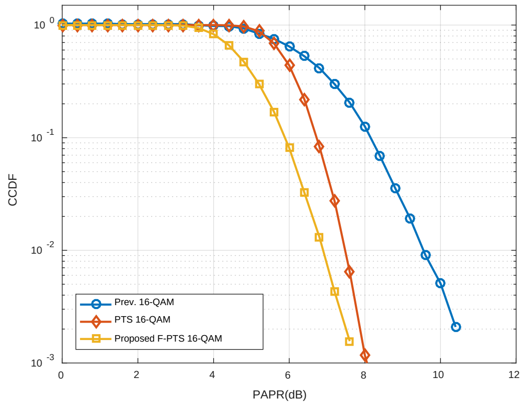

Fig.4.1 PAPR vs CCDF Performance Graph of Proposed System using 16-QAM.

Fig. 4.1 shows the MATLAB scope screen of PAPR vs CCDF Performance Graph of proposed 16-QAM modulation. Three different color lines represents three different methods top one represents previous 16-QAM, middle on represents PTS-16-QAM, where as bottom one figure represents proposed F-PTS with 16QAM modulation.

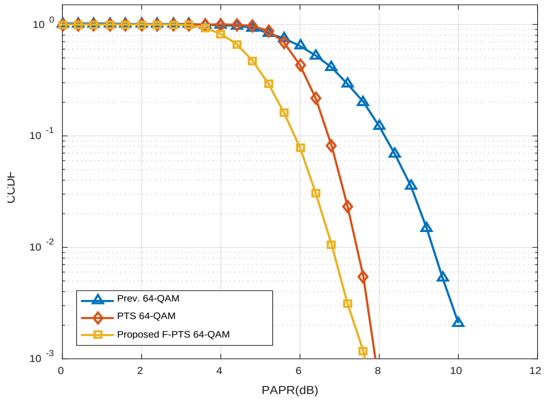

Fig.4.2 PAPR vs CCDF Performance Graph of Proposed System using 64-QAM.

Fig. 4.2 shows the MATLAB scope screen of PAPR vs CCDF Performance Graph of proposed 64-QAM modulation. Three different color lines represents three different methods top one represents previous 64-QAM, middle on represents PTS-64-QAM, where as bottom one figure represents proposed F-PTS with 64-QAM modulation

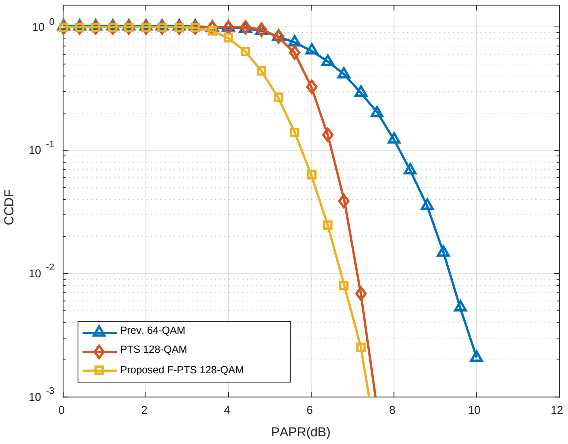

Fig.4.3 PAPR vs CCDF Performance Graph of Proposed System using 128-QAM.

Fig. 4.3 shows the MATLAB scope screen of PAPR vs CCDF Performance Graph of proposed 128-QAM modulation scheme. Three different color lines in graph represents three different methods top one represents previous 128-QAM, middle on represents PTS-128-QAM, where as bottom one figure represents proposed F-PTS with 128-QAM modulation.

V. CONCLUSION

This investigation work introduced Orthogonal Frequency Division Multiplexing (OFDM) and NC-OFDM examination, for adaptability and flexibility, the OFDM is an appealing possibility for CR frameworks. This work represents to a novel non-contiguous OFDM (NC-OFDM) strategy, where the usage accomplishes high information rates of non-contiguous subcarriers while simultaneously keeping away from any interference to the transmissions. The primary objective of this examination work was to explore PAPR mitigation strategies for contiguous bands of OFDM based framework. Simulation results of PAPR reduction has shown that the performance of F-PTS-16, 64,128 is good compared to previous modulation schemes such as.

The PAPR problem in OFDM is still an ongoing issue, especially for portable devices where the need to minimize the power amplifier linear range is paramount. The F-PTS methods developed in this work to reduce the PAPR can be combined with other PTS techniques such as adaptive PTS and variations of the blind SLM techniques to further reduce complexity and the peak power.

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