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Enhancement of PAPR Reduction Using Pso Based Optimization Technique

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***Abstract* -A non-constant envelope with high peaks is a main disadvantage of Orthogonal Frequency Division Multiplexing (OFDM). These high peaks produce signal excursions into non-linear region of operation of the Power Amplifier (PA) at the transmitter, thereby leading to non-linear distortions and spectral spreading. Many Peak to Average Power Ration (PAPR) reductions methods have been proposed in the literature. The objective of this review is to give a clear understanding of different techniques to reduce PAPR of the signal.**

***Keywords* -OFDM, PAPR, PA**

I. INTRODUCTION

With increased demand for high quality communication services in 4G and 5G, it's been a great challenge to improve the Quality of Service (QoS) and reduces the delay time. To overcome and fulfill this requirement, a technique called Orthogonal Frequency Division Multiplexing (OFDM) is encountered. It over several outfalls like maintaining high data rate, high bandwidth efficiency, low computational complexity and eliminating multipath fading [1-2-3].

OFDM is a special case of the frequency division multiplexing (FDM), which is used by the American National Defense Department for military communications. Compared with the conventional FDM, OFDM allows the spectrums from different subcarriers that are orthogonal to be overlapped with each other, which improves the spectral efficiency of the system. The concept of OFDM techniques was first proposed by RW Chang in 1965. In 1967, Saltzberg analyzed the performance of OFDM systems. In 1970, OFDM technology was patented at the USPD and then after it was used in military communication systems.

In 1971, SB Weinstern and PM Ebert employed the Discrete Fourier Transform (DFT) into the MCM. in practice, the Fast Fourier Transform (FFT) implementation of the DFT has made OFDM modulation and demodulation feasible and very successful. In the 1980s, ISI was decreased when Peled and Ruiz added cyclic prefix (CP) into the basic OFDM signals to have the orthogonality maintenance among subcarriers [4-5].

II. OFDM SYSTEM AND PAPR

1. OFDM system

Orthogonal frequency division multiplexing (OFDM) is a most efficient and widely used multiplexing and modulation technology for 4G and 5G telecommunications standards which includes digital radio broadcasting, digital terrestrial television (DTT),

wireless local area networks (LANs), etc. OFDM systems consist of two parts the transmitter side and the receiver side [6]. OFDM transceiver The fundamental principle of OFDM is to split the available bandwidth into multiple sub-carriers. As the number of subcarriers increases, it gets more immune to frequency selective fading, and data rates are also increasing. However, number of sub-carriers cannot be increased arbitrarily because it increases the complex architecture of the system and symbol durations that make transmission more sensitive to the time incoherence of the channel.

The problem of the intricate design of the system was handled by Weinstein and Ebert with the implementation of OFDM modulation by Inverse Discrete Fourier Transform (IDFT) and demodulation by Discrete Fourier Transform (DFT). To illustrate this considers one OFDM symbol with N different subcarriers and assume that s(t) is sampled at every time interval Ts=N (Figure 1).

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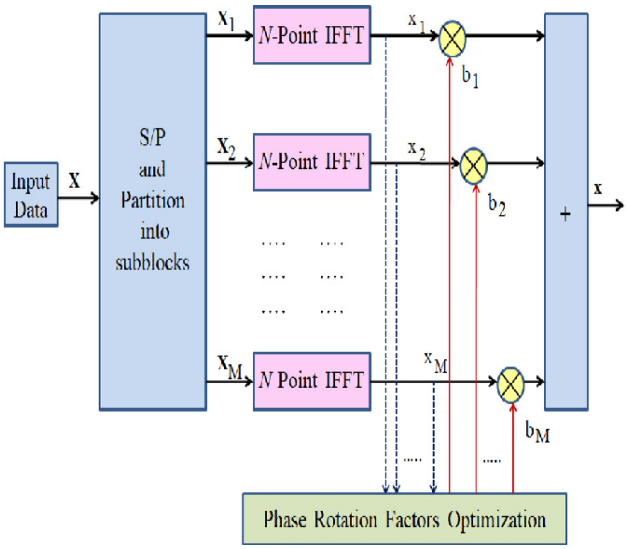

Fig.2 OFDM system.

III. PAPR REDUCTION TECHNIQUES

The PAPR reduction includes many techniques, and it's dependent on various factors such as Spectral efficiency, Reduction Capacity, increasing of Transmit signal power, loss in data rate, Computation Complexity, increase in BER, Peak Reduction Carrier. The PAPR reduction techniques have been proposed in order to reduce the PAPR [7-8] as much as possible. Some of them are: Clipping and filtering

- Coding
- Partial Transmit Sequence (PTS)
- Selected Mapping (SLM)
- Tone Reservation (TR)
- Tone Injection (TI)
- Active Constellation Extension (ACE)
- Companding

IV. PROPOSED METHODE INTRODUCTION OF PSO

In computational science, particle swarm optimization (PSO) is a computational method that optimizes a problem by iteratively trying to improve a candidate solution with regard to a given measure of quality. It solves a problem by having a population of candidate solutions, here dubbed particles, and moving these particles around in the search-space according to simple mathematical formulae over the particle's position and velocity. Each particle's movement is influenced by its local best known position, but is also guided toward the best known positions in the search-space, which are updated as better positions are found by other particles. This is expected to move the swarm toward the best solutions.

1. How To Work Pso Algorithm:

Particle Swarm Optimization might sound complicated, but it's really a very simple algorithm. Over a number of iterations, a group of variables have their values adjusted closer to the member whose value is closest to the target at any given moment. Imagine a flock of birds circling over an area where they can smell a hidden source of food. The one who is closest to the food chirps the loudest and the other birds swing around in his direction. If any of the other circling birds comes closer to the target than the first, it chirps louder and the others veer over toward him. This tightening pattern continues until one of the birds happens upon the food. It's an algorithm that's simple and easy to implement.

The algorithm keeps track of three global variables:

- Target value or condition
- Global best (gBest) value indicating which particle's data is currently closest to the Target.
- Stopping value indicating when the algorithm should stop if the Target isn't found.

2. Each particle consists of - Data representing a possible solutionA Velocity value indicating how much the Data can be changedA personal best (pBest) value indicating the closest the particle's Data has ever come to the Target The particles' data could be anything. In the flocking bird's example above, the data would be the X, Y, Z coordinates of each bird. The individual coordinates of each bird would try to move closer to the coordinates of the bird which is closer to the food's coordinates (gBest). If the data is a pattern or sequence, then individual pieces of the data would be manipulated until the pattern matches the target pattern.

The velocity value is calculated according to how far an individual's data is from the target. The further it is, the larger the velocity value. In the bird's example, the individuals furthest from the food would make an effort to keep up with the others by flying faster toward the gBest bird. If the data is a pattern or sequence, the velocity would describe how different the pattern is from the target, and thus, how much it needs to be changed to match the target.Each particle's pBest value only indicates the closest the data has ever come to the target since the algorithm started.

The best value only changes when any particle's pBest value comes closer to the target than gBest. Through each iteration of the algorithm, gBest gradually moves closer and closer to the target until one of the particles reaches the target. It's also common to see PSO algorithms using population topologies, or "neighborhoods", which can be smaller, localized subsets of the global best value.

These neighborhoods can involve two or more particles which are predetermined to act together, or subsets of the search space that particles happen into during testing. The use of neighborhoods of ten help the algorithm to avoid getting stuck in local minima.

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2. The Algorithm

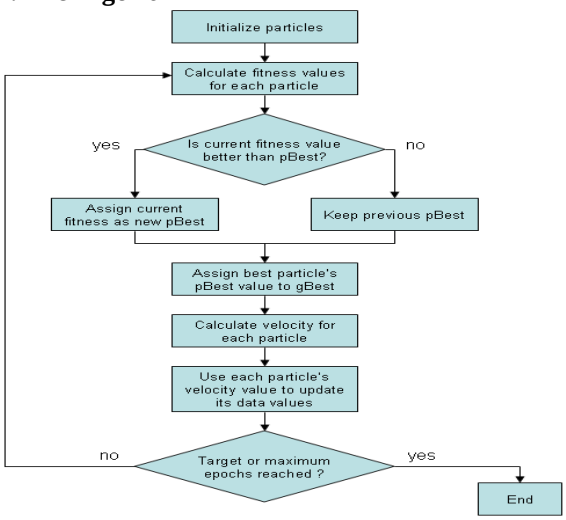

Fig.3 Flow diagram illustrating the particle swarm optimization algorithm.

3. How minimization BER and PSO parameter control:

From the above case, we can learn that there are two key steps when applying PSO to optimization problems: the representation of the solution and the fitness function. One of the advantages of PSO is that PSO take real numbers as particles. It is not like GA, which needs to change to binary encoding, or special genetic operators have to be used. For example, we try to find the solution for f(x) = x1^2 + x2^2+x3^2, the particle can be set as (x1, x2, x3), and fitness function is f(x). Then we can use the standard procedure to find the optimum. The searching is a repeat process, and the stop criteria are that the maximum iteration number is reached or the minimum error condition is satisfied. There are not many parameter need to be tuned in PSO. Here is a list of the parameters and their typical values.

4. Data Set In Form Of Ber And Snr: the typical range is 20 - 40. Actually for most of the problems 10 particles is large enough to get good results. For some difficult or special problems, one can try 100 or 200 particles as well.

5.Dimension Of Ber And Snr: It is determined by the problem to be optimized Range of particles: It is also determined by the problem to be optimized, you can specify different ranges for different dimension of particles.

6. Distance To Covered Maximum Snr: it determines the maximum change one particle can take during one iteration. Usually we set the range of the particle as the Vmax for example, the particle (x1, x2, x3) X1 belongs [-10, 10], then Vmax = 20.

7. LEARNING FACTORS: c1 and c2 usually equal to 2. However, other settings were also used in different papers. But usually c1 equals to c2 and ranges from [0, 4]

8. The Stop Condition Maximum Ccdf- the maximum number of iterations the PSO execute and the minimum error requirement. For example, for ANN training in previous section, we can set the minimum error requirement is one mis-classified pattern. The maximum number of iterations is set to 2000. This stop condition depends on the problem to be optimized.

9. Global Version Vs. Local Version: we introduced two versions of PSO. Global and local version. Global version is faster but might converge to local optimum for some problems. Local version is a little bit slower but not easy to be trapped into local optimum. One can use global version to get quick result and use local version to refine the search.

Another factor is inertia weight, which is introduced by Shi and Eberhart. If you are interested in it, please refer to their paper in 1998. (Title: A modified particle swarm optimizer) As stated before, PSO simulates the behaviors of bird flocking. Suppose the following scenario: a group of birds are randomly searching food in an area. There is only one piece of food in the area being searched. All the birds do not know where the food is. But they know how far the food is in each iteration. So what's the best strategy to find the food? The effective one is to follow the bird which is nearest to the food. PSO learned from the scenario and used it to solve the optimization problems. In PSO, each single solution is a "BER AND SNR" in the search space. We call it "DATA SAMPLE". All of particles have fitness values which are evaluated by the fitness function to be optimized, and have velocities which direct the flying of the particles. The particles fly through the problem space by following the current optimum particles.

PSO is initialized with a group of random particles (solutions) and then searches for optima by updating generations. In every iteration, each particle is updated by following two "best SNR" values. The first one is the best solution (fitness) it has achieved so far. (The fitness value is also stored.) This value is called p best. Another "best" value that is tracked by the particle swarm optimizer is the best value, obtained so far by any particle in the population. This best value is a global best and called gbest. When a particle takes part of the population as its topological neighbors, the best value is a local best and is called lbest.

10. Peak-to-Average Power Ratio (PAPR) CCDF Parameter With Pso:

Peak-to-Average Power Ratio (PAPR) is an important parameter for the analysis of Orthogonal Frequency Division Multiplexing (OFDM) signals. CCDF curves are known to have great importance in the study of signal performance on the basis of power level. This paper presents the CCDF performance of the OFDM signal with different number of carriers. Simulation is used to implement the CDF equation and its accuracy is checked on the results. Theoretical results and simulation results are compared. Peak-to-Average Power Ratio (PAPR) is an important parameter for the analysis of orthogonal frequency division multiplexing (OFDM) signals. CCDF

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curves are known to have great importance in the study of signal performance on the basis of power level. This paper presents the CCDF performance of the OFDM signal with different number of carriers. Simulation is used to implement the CDF equation and its accuracy is checked on the results. Theoretical results and simulation results are compared.

Our base paper propose a simple technique for the reduction of high Peak to Average Power Ratio (PAPR), based on Clipping and Differential Scaling Selected mapping (SLM) is a promising peak-to-average power ratio (PAPR) reduction technique for orthogonal frequency division multiplexing (OFDM) system Partial transmit sequence (PTS), is one of the most attractive method to reduce the PAPR in OFDM systems. It achieves considerable PAPR reduction without Distortion Power Complementary Cumulative Distribution Function (CCDF) curves provide critical information about the signals encountered in 3G systems. These curves also provide the peak-to-average power data needed by component designers.

This application note examines the main factors that affect power CCDF curves, and describes how CCDF curves are used to help design systems and components. When are CCDF curves used? Perhaps the most important application of power CCDF curves is to specify completely and without ambiguity the power characteristics of the signals that will be mixed, amplified, and decoded in communication systems. For example, baseband DSP signal designers can completely specify the power characteristics of signals to the RF designers by using CCDF curves. This helps avoid costly errors at system integration time. Similarly, system Manufacturers can avoid ambiguity by completely specifying the test signal parameters to their amplifier suppliers. CCDF curves apply to many design applications. Some of these applications are:

- Visualizing the effects of modulation formats.
- Combining multiple signals via systems components (for example, amplifiers).
- Evaluating spread-spectrum systems.
- Designing and testing RF components [9-10-11].

$$P(PAPR \leq y) = \left(1 - e^{\frac{-y^4}{2\sigma^2}}\right)$$

$$CCDF = 1 - \left(1 - e^{\frac{-y^4}{2\sigma^2}}\right)^N$$

V. RESULTS OBTAINED

The all channel fading channel is constructed using the toolbox in Matlab R2015a using the channel function with different values of, which is also known as (k) factor. The signal is passed through this channel using the filter function with different SNR values the same is done for Rician channel. The channel is constructed using Rician channel function with the same sampling period and here we have taken the snr value 20. The comparison of the different results is done. It can be easily visualized that the variation of the BER is reduced with different values of Doppler sift .The packet loss is reduced and the BER is improved.

1. The Rician *K* factor- defined as the ratio of signal power in dominant component over the scattered, reflected power, is a very important in understanding the behavior of a short-range wireless channel. It determines the distribution of the received signal amplitude. Knowledge of the Rician *K* factor can be useful in determining the bit error rate of a channel among other useful metrics. This *K* factor is very difficult to measure directly, i.e., by physically isolating the direct wave from the scattered components. However, the *K*-factor can be estimated from a set of different samples of the channels, for instance at different frequencies.

The method of matching first and second moments was used to determine the Rician *K* factor. This method sets the sample mean equal to the theoretical mean (both of the received signal amplitude). The following equation shows the theoretical mean of a Rician distributed random variable.

2. Rayleigh fading- is a statistical model for the effect of a propagation environment on a radio signal, such as that used by wireless devices.Rayleigh fading models assume that the magnitude of a signal that has passed through such a transmission medium (also called a communication channel) will vary randomly, or fade, according to a Rayleigh distribution — the radial component of the sum of two uncorrelated Gaussian random variables. Rayleigh fading is viewed as a reasonable model for tropospheric and ionosphere signal propagation as well as the effect of heavily built-up urban environments on radio signals. Rayleigh fading is most applicable when there is no dominant propagation along a line of sight between the transmitter and receiver. If there is a dominant line of sight, fading may be more applicable. Rayleigh fading is a special case of two-wave with diffuse power (TWDP) fading[12].

Table 1 Parameters

K value	Allow of snr
K=1	0.010
K=10	0.015
K=100	0.045

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Table 1 is shows by the value of k is increasing then Allow of snr is also decreasing. Hence applied k different different value for different modulation shows by snr and BER relation.

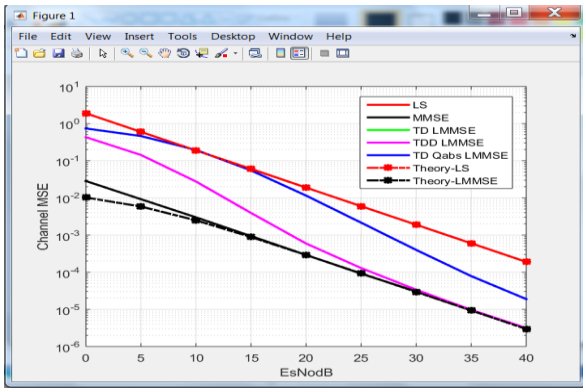

Fig. 1 Channel MSE and E/N Plot MIMO-OFDM.

Fig.1 Channel MSE and E/N Plot shows by various channel estimation techniques outputs now graphs conclude-

1. LS Estimator: Simple vector division. Highest MSE Gives.

2. OLR-MMSE Estimator: Avoid matrix inversion and also simplify the matrix operations to the calculations between a low-rank diagonal matrix and a unitary matrix.

3. MMSE Estimator: Matrix inversion and other operations with size N, where N is the DFT size (typically 256, 512, 1024, or 2048).These are gives lowest MSE for maximum SNR.

4. LS Estimator with 1D interpolation (LI, SOI, SCI, LPI, TDI): Simple estimation and interpolation methods. Interpolation methods are relatively complex, with fitted polynomial search, low pass convolution, and DFT/IDFT calculation, respectively.

5. ML Estimator: Matrix inversion with size (L + 1), where L ranges from N/32 to N/4, and other matrix operations with size N.

6. Theory LMMSE Estimator: Tracking the number of resolvable paths (M) and channel delays, and matrix inversion with size M, and other matrix operations with size N.

Proposed method result:

1. BPSK modulation technique:

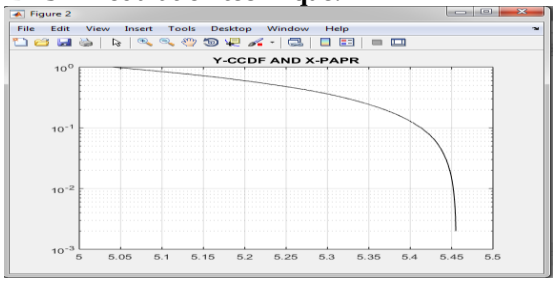

Fig.2 CCDF Vs PAPR Output using PSO algorithm BPSK modulation technique MIMO-OFDM.

Fig. 2 is represent for CCDF Vs PAPR output for fixed PSO iteration it gives for 10^{-2} CCDF in 5.45 db PAPR. Hence improved output and reduced PAPR as compared to base paper.

2.16QAM Modulation technique:

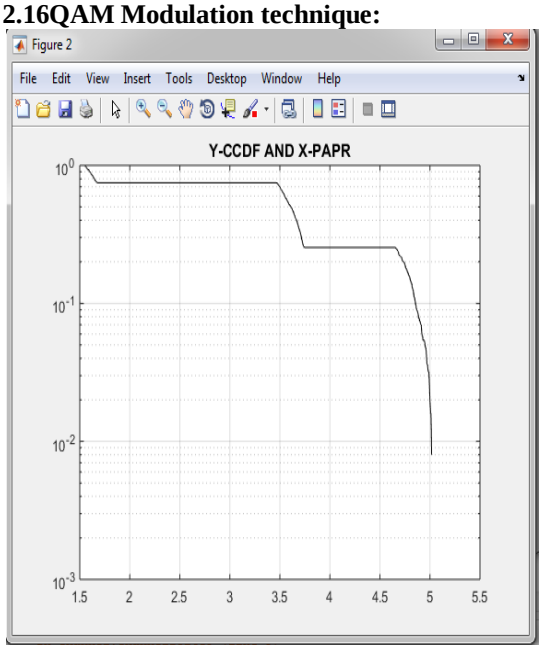

Fig.3 CCDF Vs PAPR Output using PSO algorithm 16QAM Modulation technique MIMO-OFDM.

Fig. 3 is represent for CCDF Vs PAPR output for fixed PSO iteration it gives for 10^{-2} CCDF in 5 db PAPR. Hence improved output and reduced PAPR as compared to base paper. Also PAPR increased as compared QPSK modulation technique.

3. 64QAM

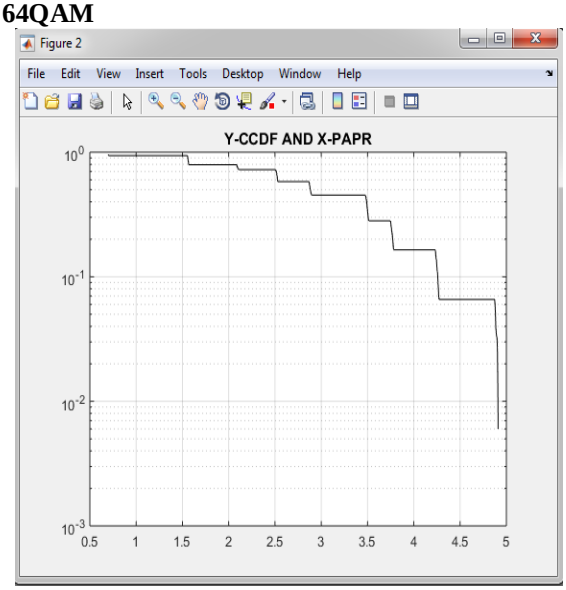

Fig. 4 CCDF Vs PAPR Output using PSO algorithm 64-QAM Modulation technique MIMO-OFDM.

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Fig. 4 is represent for CCDF Vs PAPR output for fixed PSO iteration it gives for $10^{-2.3}$ CCDF in 4.59 db PAPR. Hence improved output and reduced PAPR as compared to base paper. Also PAPR increased as compared 16-QAM modulation technique.

Base Paper Result:

FFT SIZE	Hybrid(PAPR dB)	PTS(PAPR dB)	Original PAPR(dB)
256	8.5	8.7	10.3

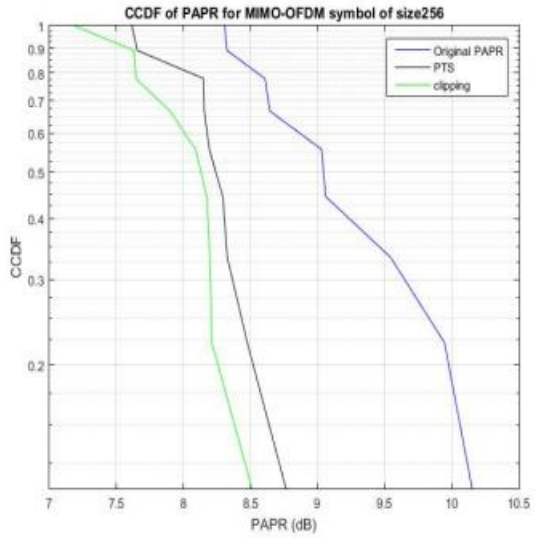

Fig. 5 CCDF Analysis for PAPR of MIMO-OFDM.

Table 2 Parameters

Modulation Technique	Papr (Db)
Base Paper	8.5
Bpsk	5.49
16qam	5
64qam	4.59

Table 2 Parameters Shows for different modulation technique give for output of CCDF and PAPR. Hence result is indicates for QPSK gives minimum PAPR but maximum MIMO system are transferred lot of bit in 64-QAM hence ITS Gives 1.49 db PAPR. Now table 5.2 are shows better result for our base paper. Now it gives improved output.

VI. CONCLUSION AND FUTURE SCOPE

In this paper, we have analyzed and compared eight PAPR reduction techniques. Among above analyzed techniques, it was found out that from present techniques no technique is fully effective in reduction of PAPR and is the best for the OFDM system. As before choosing the appropriate PAPR technique, various other factors like maintaining data rate, computational complexity, BER, signal power should also be taken into acknowledgement. So, it is suggested to propose peak to average power ratio (PAPR) reduction scheme and design a network/model supporting it for OFDM systems after comparing existing conventional methods.

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