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Weight Pattern based Adaptive Constant Modulus Optimization Technique: A Novel Approach to PAPR Reduction For Wireless VOIP

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ABSTRACT

4G is the recent flawless mobility network, enhancing the tech world by providing greater data rate & wider coverage over its older generations but still some drawbacks are encountered. The most needed amendment and requirement was of intelligent mobility management techniques that use IP technology to achieve global roaming among various access technologies. One way is use of 4G, wherein spectral efficiency, capacity, latency & high data rate were available. To further achieve these services, the 4G network is based on IP protocol of packet switching system. The use of 4G introduces limitations in QoS in uplink due to high value of PAPR, which results in lesser efficiency caused by cyclic/guard interval, lesser frequency synchronization & more chances of Doppler Shift. So to reduce PAPR by keeping the complexity as low as possible as compared to existing techniques used for PAPR reduction. Otherwise PAPR in uplink could lead to higher bit rate error, less spectral efficiency & channel aliasing resulting in amplification in HPA, increased complexity & higher cost. A novel PAPR reduction technique is proposed, inspired by CMA property known as WPACMOT for wireless VOIP services. Hence to change scales of convergence with alter step size for optimal solution. Simulation shows the efficacy of projected technique.

Keywords: CMA (Constant Modulus Algorithm), LSE (Least Square Error), LTE (Long Term Evolution), OFDM (Orthogonal Frequency Division Multiplexing), PAPR (Peak-to-Average Power Ratio), PTS (partial transmit sequence), SQP (Sequential Quadratic Programming), VOIP (Voice Over Internet Protocol), WPACMOT (Weight Pattern based Adaptive Constant Modulus Optimization Technique).

INTRODUCTION

The calls or speeches are handled as VoIP in the 4G.VoIP does not require any extra internet infrastructure as it uses the existing infrastructures. Therefore it is highly cost effective but the Quality of Service (QoS) is affected in mobile network. Broadband wireless network such as WiMAX uses VoIP, thus lessening the delay in mobile network which could otherwise degrade the quality [1]. Worldwide Interoperability for Microwave Access (WiMAX) and LTE are very significant for the betterment and advancement of the 4G network. WiMAX mobile version IEEE802.16e helps in solving the delay–sensitive problem of VoIP service and makes the downlink perfect.

21st century has marked an increasing the need and development of better and fast wireless network .Mobile broadband communications such as WiMAX, 3rd generation Partnership Project (3GPP), LTE etc are important wireless technologies having high data rate and wider coverage. Recently new heterogeneous wired and wireless network called 4G (fourth generation) have emerging with wide development in the technology market. It has provision of multiple interfaces and flawless transmission of data over heterogeneous networks as well. Need of the hour is free roaming across various technologies such as wireless local area networks (WLANs), WiMAX networks etc. [2]. 4G aims at providing transmission rate of 20 Mbps with high QoS features [3] as well as replacing the whole core of cellular network with single standardized worldwide cellular network based on IP for uniform video, packet data utilizing, VoIP and multimedia services [3]. 4G services will be upgradable to new protocols and services via software upgrades using software defined radios.4G is not a completely new technology , it is rather a concept aiming at providing integration and convergence for proper exchange of communication between different wireless networks with the wire line backbone as well by downward compatibility.

In today's fast changing world of technology, advancement over 3G technologies is the fourth generation 4G wireless broadband technologies. As in present era of 4G, and with the rapid growth in the field of communications, especially for the case of multimedia services which requires large information/data rate can use number of modulation schemes. OFDM is one of such modulation scheme that uses large information/data rates to transmit and receive multimedia services using wireless and wired channels. OFDM modulation scheme uses the concept of multicarrier which helps to handle the growing demand of information/data rates. It falls under the category of physical layer that assures information/data rate of 6Mbps to 54Mbps over the wired and wireless channels [4].OFDM has been widely used in many communication standards such as Digital Video Broadcasting (DVB) and mobile based worldwide interoperability for microwave access (WiMAX).

PEAK-TO-AVERAGE POWER RATIO

There are some inevitable concerns remain unresolved in the design of the OFDM systems. One of the most important problems is high Peak-to-Average Power Ratio (PAPR) of transmitted SC-OFDM signals. In a multicarrier system when the

dissimilar sub-carriers are out of phase with each other, problem of PAPR arises. At every instant they are dissimilar with respect to each other at diverse phase values. When all the points attain the greatest value concurrently; this will results in the output envelope to abruptly shoot up which causes a 'peak' in the output envelope. The peak value of the system can be very high as compared to the average of the whole system when there is large number of independently modulated subcarriers. This ratio of the peak to average power value is termed as PAPR [5]. Therefore for advancement of the OFDM systems it is essential to reduce this problem.

WEIGHT PATTERN BASED ADAPTIVE CONSTANT MODULUS OPTIMIZATION TECHNIQUE

Ideally frequency modulated or phase modulated signals have constant amplitude, thus the signal is said to have constant Amplitude or constant modulus. The CMA is efficient blind algorithm which is used in many practical applications because it does not need carrier synchronization. The WPACMOT is a weight pattern based optimization algorithm which is applied on the full system and update the control parameters until it converges to optimal solution. An average power is kept constant to modulate the transmission signal. Weights are adjusted to change the scale of problem to reach to global optimal solution. The following are the steps.

- Input the data to the OFDM system.
- Calculate actual and expected value. Find error and set current state value.
- To change solution scale, set weight patterns w1 and w2 and to converge at optimal solution set step size of weight patterns.
- Set average power constant and magnitude of average power can be adjusted by the weight patterns.
- Then transmit constant magnitude signal.
- Track for optimized converged solution and find threshold error.

SIMULATION RESULTS

Test system [11] under study is OFDM system. PAPR is calculated using WPACMOT on OFDM system. WPACMOT is successfully developed and tested on OFDM system. From test results, PAPR comes out to be less as compared to other techniques in literature.

Table I show the calculated PAPR based on weight pattern adaptive constant modulus optimization technique. In this, when weight pattern values w1=0.65, w2=0.35 are taken to find optimal solution, it converges very quickly. The PAPR value for this set of weight patterns is investigated as 4.713 in seventh iteration. Different PAPR values are investigated with different set of weight patterns and most excellent result was observed at 7^{th} iteration.

TABLE I: WEIGHT PATTERNS WITH PAPR

Weight Pattern w1	Weight Pattern w2	PAPR (dB)
0.5	0.5	5.6
0.2	0.8	5.4
0.3	0.7	5.3
0.4	0.6	5.7
0.6	0.4	5.1
0.65	**0.35**	**4.7**
0.75	0.25	4.9
0.8	0.2	4.8

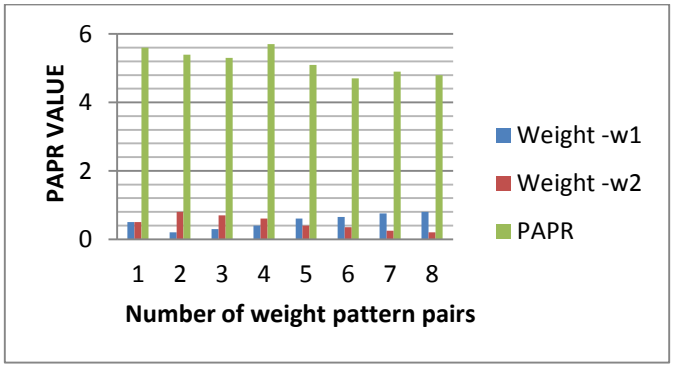


Fig. 1. Weight Pattern Analysis

Fig. 1 shows PAPR weight pattern analysis and most excellent results was experimental at w1=0.65 and w2=0.35.Table II, shows the PAPR analysis with different number of iterations. 7th iteration is selected to arrive at most approving result with quick convergence. This gives the PAPR value of 4.713 by consuming 1.449669 seconds of time. The further decrease of PAPR is achievable by raising the number of iterations, but this will increase the complexity of the system. Using novel WPACMOT, it gives the lower value of CCDF as compared to original PAPR (without implementation of WPACMOT) value. In 7th iteration it shows that reduced PAPR value by WPACMOT occurs as comparison to other iterations. WPACMOT PAPR values are compared with already used techniques in Table III. The techniques which are already implemented in the literature are PTS, SDCMA,

TABLE II

PAPR ANALYSIS WITH ITERATIONS OTHER TECHNIQUES FOR PAPR

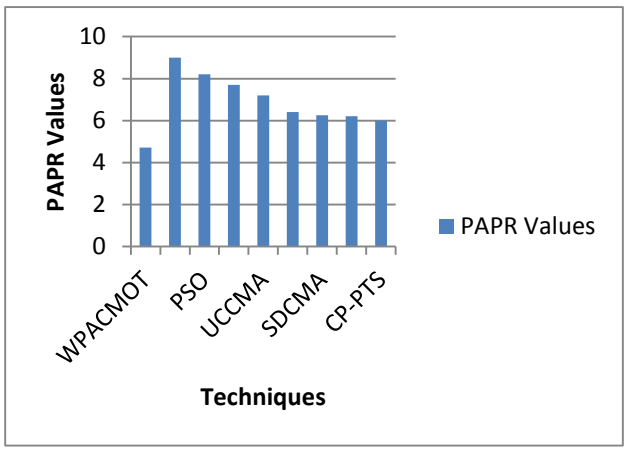
Iterations	Original PAPR Value(dB)	WPACMOT PAPR Value(dB)	Time taken (sec)
1	9.403	5.146	1.620732
2	8.457	5.289	1.406414
3	8.323	5.488	1.417950
4	8.858	5.065	1.421172
5	10.533	5.225	1.385902
6	9.515	4.924	1.405169
7	**8.335**	**4.713**	**1.449669**
8	9.341	5.013	1.393694
9	10.025	5.145	1.421692
10	9.436	4.934	1.417155

TABLE III

COMPARATIVE ANALYSIS WITH

Techniques	PAPR Value (dB)
WPACMOT	4.713
PTS[23]	7.7
SDCMA[21]	6.25
CP-PTS[21]	6
UCCMA[21]	7.2
PSO[23]	8.2
LSE[22]	9
SQP[22]	6.4
Advanced SQP[22]	6.2

CP-PTS, PSO, SQP, and LSE are compared with WPACMOT PAPR. Comparison in Table III shows that WPACMOT PAPR values is the lowest as compared with existing methods. Fig. 2 shows the graphical representation of comparison between proposed technique and with other



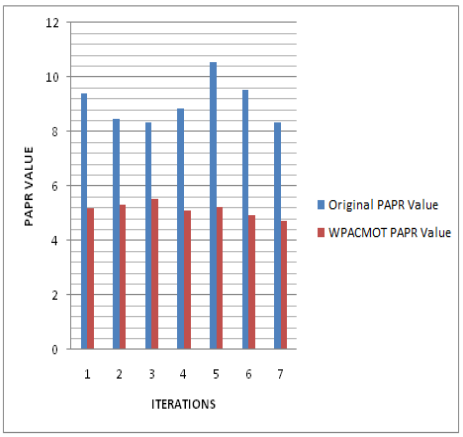


Fig.2. PAPR Analysis Fig.3.Comparison of Original PAPR and WPACMOT at all Iterations

methods used for PAPR reduction on the same system. The decrease in PAPR value at all iteration is shown in Fig.3 by comparing original PAPR value and WPACMOT PAPR value. Figure 4 shows the better BER performance of the proposed system in comparison with AWGN channel. It shows that with proposed technique system performs better than AWGN and also BER performance of our system is not affected after using WPACMOT. This motivates the use of WPACMOT.

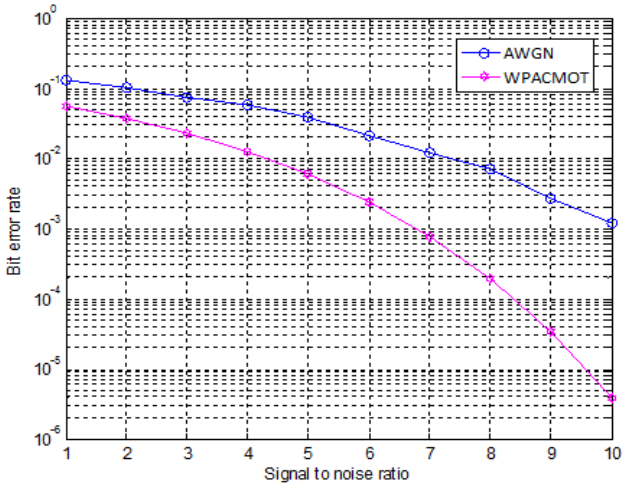


Fig. 4 BER vs S/N Ratio Performance

CONCLUSIONS

In this paper, WPACMOT technique is proposed to solve PAPR reduction in uplink of 4G OFDM system. For VOIP applications weight pattern functionality is incorporated to enhance the solution search capability of proposed method. Results show that the reduced PAPR value will only turn out with the help of WPACMOT as compared to other methods like PSO, SQP, ASQP, PTS, and CP-PTS. Therefore, WPACMOT is effective in solving the problem of PAPR in uplink for 4G in wireless VOIP applications. Additional, hybrid techniques can be integrated with additional constraints to work out the difficulty of PAPR in uplink system of 4G.

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