ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

PAPR Reduction in MIMO-OFDM Systems LTE-Advanced System

Nupur Baisakhiya
Electronics and Communication Engineering,
Mahakal Institutre of Technology (MIT), Ujjain.

Gaurav Gupta (M.Tech)
Professor & HOD,
Mahakal Institute of Technology (MIT), Ujjain.

Abstract:

The paper addresses PAPR Reduction in MIMO-OFDM Systems LTE-Advanced System particularly to exploit full diversity freeing of adding extra overhead of pilot sequence, which is anticipated widely deployed in the near future. The combination of SFBC and CDD is able to introduce additional time diversity and hence significant gains from the spatial, frequency, time diversity gains can be efficiently exploited associated with it. Furthermore, for eight transmit antenna case, numerical simulation results under different modulation modes and coding rates scenarios are given to show that the proposed scheme outperforms previous schemes such as pure quasi-orthogonal space-frequency coded OFDM (QO-SFBC) and CDD scheme in terms of block error rate (BLER) and therefore the new scheme enables transmission reliability and coverage without significantly increasing system complexity. The proposed Partial Transmit Sequence for reducing the Peak-to- Average Power Ratio (PAPR) in MIMO –OFDM systems is to achieve better PAPR performance, a quite large calculation cost must be demanded and the number of sub-blocks should be increased which is the sub-blocks using phase rotation factors to minimize PAPR over all transmit antennas and receive antennas.

Keywords:

Block error rate (BLER) , Partial Transmit Sequence, Peak-to- Average Power Ratio (PAPR), SFBC+CDD transmitter.

1.Introduction:

To reduce the computational complexity for searching rotation phases in PTS, various suboptimal methods that achieve significant reduction in complexity were presented in. Owing to an intensive improvement of circuit design for genetic algorithms (GAs) in recent years PTS based on GAs not only has moderate PAPR reduction performance but also shows potential for practical implementation among these methods. The GA has proved to be a robust, domain-independent mechanism for numeric and symbolic optimization. With the trend of GA hardware becoming more popular and low-priced, the PTS based on GA may provide a practical and economical approach toward solving the difficulty of high PAPR in OFDM systems. Previous studies have demonstrated that the BGA PTS achieves a moderate PAPR reduction in discrete domains. However, rotation phases involved in this phase-searching problem are real-valued radians.

This prompts consideration of a novel implementation of PTS to reduce the PAPR based on a real-valued genetic algorithm (RVGA) method. In the proposed RVGA method, a cost function related to the amount of PAPR is first defined. The cost function is then translated into a real-valued parameter optimization problem, which can be solved effectively by the RVGA. The simulation results show that the performance of the proposed RVGA PTS along with an extinction and immigration strategy provides a PAPR statistic approaching that of the exhaustive PTS while maintaining a low computational load.

2.Transmit diversity:

A transmitter diversity technique for wireless communications over frequency selective fading channels is presented. The proposed technique utilizes orthogonal frequency division multiplexing (OFDM) to transform a frequency selective fading channel into multiple flat fading sub channels on which space-frequency processing is applied. Simulation results verify that in slow fading environments the proposed

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

space-frequency OFDM (SF-OFDM) transmitter diversity technique has the same performance as a previously reported space-time OFDM (ST-OFDM) transmitter diversity system but shows better performance in the more difficult fast fading environments.

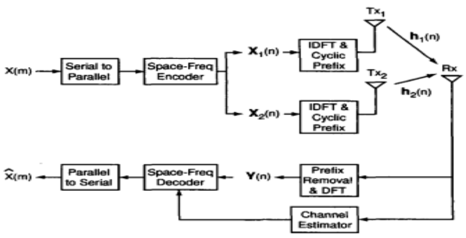


Figure: Block diagram of the proposed two-branch space frequency OFDM transmitter diversity system

The supply knowledge is connected by parity bits, that square measure generated by cyclic generator polynomials. Channel wherever the row of cryptography matrix represents subcarrier and therefore the column refers to correspondingly transmit antenna port. SFBC and CDD encoded blocks square measure reborn into OFDM blocks by inverse separate Fourier remodel (IDFT) for every antenna input blocks and N represents the scale of IDFT, k is that the index of sub-carrier. τ_i (i=1,2,3) refers to delay of modulated symbols and Alamouti-based SFBC encoded symbols at connected antenna port in time domain that is like kτ/N degree of rotation of the innovate frequency domain.

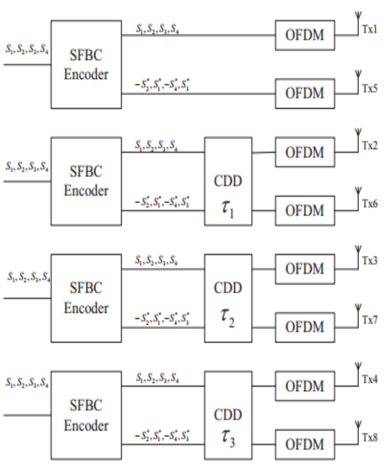


Figure1: Block diagram of SFBC+CDD transmitter

Besides its superior performance in fast fading environments, SF-OFDM transmitter diversity has other practical implementation advantages over the ST-OFDM approach, as well. Since the proposed SF-OFDM transmitter diversity scheme performs the decoding within one OFDM block, it only requires half of the decoder memory needed for the STOFDM system of the same block size. Similarly, the decoder latency for SF-OFDM is also half that of the ST-OFDM implementation. Despite the, number of advantages SF-OFDM transmitter diversity has over the ST-OFDM approach, there is one important parameter that requires careful consideration for SFOFDM transmitter diversity systems.

3.Partial transmit sequence (PTS)

Partial transmit sequence (PTS) is a capable technique for peak-to-average-power ratio (PAPR) reduction in orthogonal frequency division multiplexing (OFDM) systems. Calculation of optimal PTS weight factors via exhaustive search requires exponential complexity in the number of sub blocks; consequently, many suboptimal strategies have been developed to date. In this we introduce an efficient algorithm for computing the optimal PTS weights that has lower complexity than conventional methods. Though a drawback is that potentially high peak-to-average power ratio (PAPR) of OFDM signals. PAPR reduction techniques include block coding based on Golay sequences (with dual capabilities of error correction and peak reduction) and clipping/filtering methods. Another technique is distortion-free of low redundancy is partial transmits sequences (PTS). We introduce an efficient algorithm for computing the optimal PTS weights that has lower complexity than conventional methods. Suboptimal PTS strategies include the following. The iterative flipping algorithm (FA) has complexity linearly proportional to the number of sub blocks, and each phase factor is individually optimized regardless of the optimal value of other phases (it is an example of greedy algorithm). A neighbourhood search is proposed in using gradient descent search.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

By using dual layered phase sequencing to reduce complexity at the price of PAPR performance degradation. In a suboptimal strategy is developed by modifying the problem into an equivalent problem of minimizing the sum of phase-rotated vectors. Initial set of phase vectors are computed by reducing the peak amplitude of each sample and the best phase vector of the set is chosen as the final solution. Finally an orthogonal projection-based approach for computing PTS phase factors.

A.PTS Approach And Lattice Problems:

Let X = [X1, ⋯ , XN] T be a block of N symbols being transmitted where each symbol is modulated to one of the carrier frequencies {fn, n = 1, ⋯ , N}. In OFDM, the N subcarriers are chosen to be orthogonal (fn = nΔf) where Δf = 1/NT and T is the signal period. The complex envelope of the transmitted signal is

$$x(t) = \frac{1}{\sqrt{N}} \sum_{n=1}^{N} X_n e^{j2\pi f_n t} \quad 0 \le t < NT$$

The PAPR of the OFDM signal x(t) is defined as

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

$E\left[|x(t)|^2\right]$ =1 for unitary signal constellations.

To better approximate the PAPR can be oversampled by generating LN samples, where L > 1 is the oversampling factor. When L = 1, Nyquist-rate sampling is obtained.

B.PAPR problem in OFDM system:

The block diagram of OFDM system is shown in figure. The transmit signal can be generated by a simple IDFT operation, which can replace the bank of modulators and at the receiver; a DFT can be performed to recover the transmitted signal.

OFDM signal consists of n data symbols transmitted over N0 subcarriers.

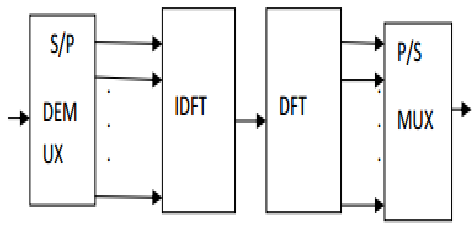


Figure: Block diagram of OFDM system

PAPR of the OFDM signal x (t) is defined as the ratio between peak power and its average power during the OFDM signal. The transmitted signal having a complex envelope is given by

$$x(t) = \frac{1}{\sqrt{N}} \sum_{n=0}^{N-1} X(n)\, e^{j2\pi f n t},\ 0 \le t \le N_0 T$$

The PAPR of the transmitted signal in (1) is defined by Where E [.] denotes expectation and complementary cumulative distribution function (CCDF) for OFDM signal can be written as CCDF = probability (PAPR> P0), where P0 is the Threshold. PAPR of OFDM signal is mathematically defined as given in

$$PAPR = 10\log_{10} \frac{\max |x(t)|^2}{\frac{1}{NT}\int_0^{NT} |x(t)|^2 dt}$$

It is easy to manipulate the above equation by decreasing the numerator max [|x (t) |²] or increasing the denominator E [|x (t) |²] . In principle, PAPR reduction techniques are concerned with reducing max x (t) . However, since most systems employ discrete-time signals, the amplitude of samples of x (t) is deal with in many of the PAPR reduction techniques. Since symbol-spaced sampling of (3) sometimes misses some of the Signal peaks and results in optimistic results for the PAPR, Oversampling by the factor L=4 to avoid the ISI. Oversampled time domain samples are obtained by LN-point IDFT of the data block with (L − 1) N zero-padding.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

It was shown in that L = 4 are sufficient to capture the peaks [7]. Lets us investigate how the PAPR grows with no of sub-carriers.

C.Impact of PAPR on the performance of MIMO OFDM systems

Peak to average power ratio (PAPR) of a transmitted signal is one of main challenges in wideband multi-carrier systems uses orthogonal frequency division multiplexing (OFDM) or multiple-input multiple-output (MIMO) OFDM. Understanding the things of PAPR on OFDM and MIMO-OFDM systems is critical when determining what techniques to use improve system performance. For the purposes of this we can use the terms OFDM and MIMO-OFDM interchangeably without disturbing the meaning of PAPR.The use of a large number of subcarriers introduces a high PAPR in OFDM systems. PAPR can be defined as the relationship between the maximum power of a sample in a transmit OFDM symbol and its average power.

$$PAPR = 10\log_{10}\frac{P_{peak}}{P_{average}}\ (dB)$$

D.Formulation of OFDM with PTS:

The functional block diagram of an OFDM system with a PTS scheme is shown in Figure . The data block $\mathbf{X}$ is partitioned into M disjoint subblocks $\mathbf{X}_m$, where m = 1, 2,..., M, such that

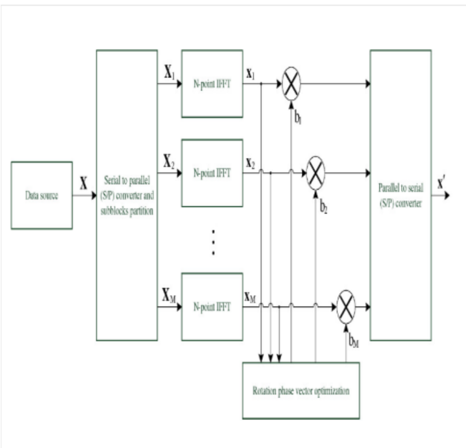


Figure: Functional block diagram of the partial transmit sequence scheme

$$\mathbf{X} = \sum_{m=1}^{M} \mathbf{X}_m.$$

Here, it is assumed that the subblocks $\mathbf{X}_m$ consist of a set of subcarriers of equal size N. The partitioned subblocks are converted from the frequency domain to the time domain using N-point IFFT.

E.PAPR reduction using PTS

In the PTS scheme the input symbol sequence is partitioned into a number of disjoint symbol sub sequences. IFFT is then applied to each symbol subsequence and the resulting signal sub sequences are summed after being multiplied by a set of distinct rotating vectors. Next the PAPR is computed for each resulting sequence and then the signal sequence with the minimum PAPR is transmitted. As the number of subcarriers and the order of modulation are increased, reducing the computational complexity becomes more important than decreasing redundancy.

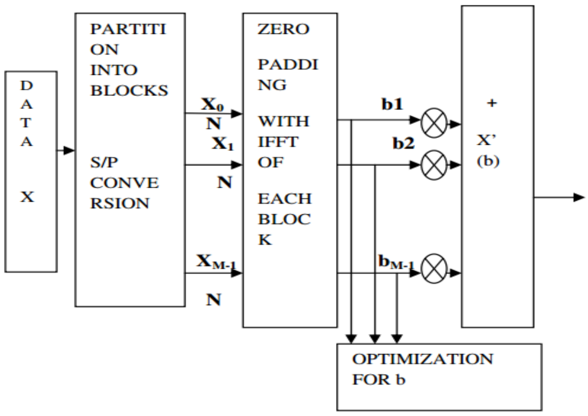
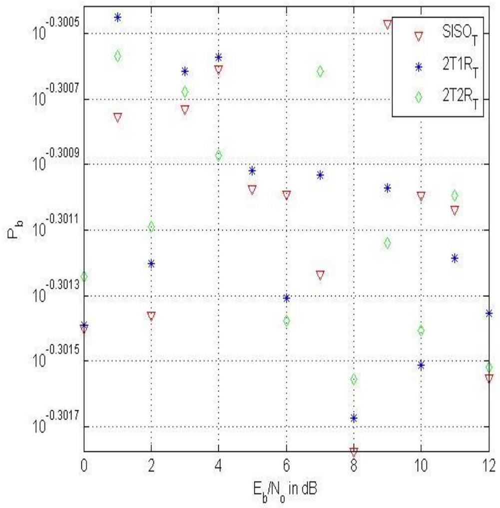
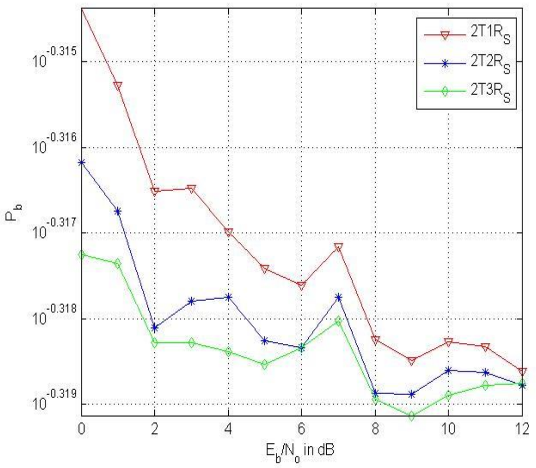


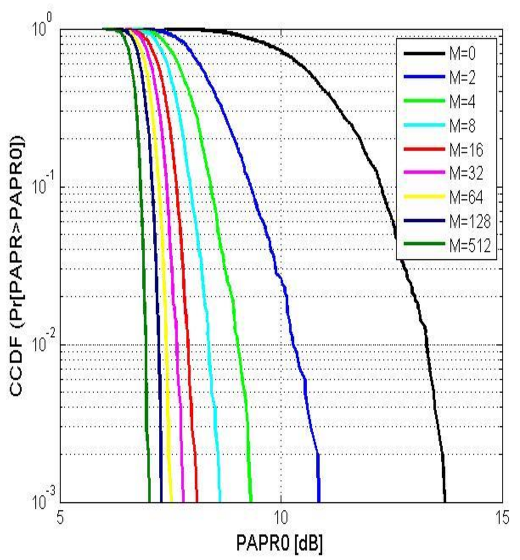
Figure: PTS-PAPR reduction scheme

4. Simulation Results

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal







5.Conclusion:

Use of OFDM has become prevalent in the advanced LTE networks. But it poses problem in power efficiency. This has lead to methods for reducing PAPR. In the proposed method we are reducing the PAPR by using PTS algorithm and also achieving the required throughput by using transmit diversity. Even when the PAPR is reduced, the QoS will not be detoriated as transmit diversity is being used. The simulation experiments were carried out using different number of users.

References:

[1] G.J.Foschini. "Layered Space-Time Architecture for Wireless Communication in a Fading Environment When using Multiple Antennas," Bell Laboratories Technical Journal, 1(2):41-59, autumn 1996.

[2] G.J.Foschini and M.J. Gans. "On the Limits of wireless Communication in a Fading Enviroment When Using Multiple Antennas". Wireless Personal Communications,6(3):311-335,1998.

[3] D.Agrawal,V.Tarokh,A. Naguib, and N.Seshadri,"Spacetime Coded OFDM for High Data-Rate Wireless Communication Over Wideband Channels,"48th IEEE Vehicular Technology Conference.Vol.3, pp.22232- 2236,May 1998.

[4] K.F. Lee and D.B.Williams,"A space-frequency transmitter diversity technique OFDM systems" in Proc. of IEEE Global Telecommunication Conference, vol.3, Nov 2000, pp.1473-1477.

[5] S.M.Alamouti,"A simple transmit diversity technique for wireless communications", IEEE J. Select Areas Commun.,vol.16 pp.1451-1458,Oct. 1998.

[6] H. Jafarkhani, "A Quasi-Orthogonal Space-Time Block Code," IEEE Transactions on Communications, Vol. 49, No.1, January 2001.

[7] G.B.Giannakis, Z.Liu, X.Ma, and S.Zhou, "Space-time Coding for Broadband Wireless Communications", John Wiley & Sons, Inc.January 2007.

[8] Sili Lu, Balachander Narasimhan and Naofal Al-Dhahir, " Reduced-Complexity ICI Mitigation for Mobile SFBCOFDM with Application to DVB-H" in

Proceedings of IEEE Wireless Communication Networking 2008,pp.1183-1187.
[9] 3GPP TS 36.211V8.6.0.Evolved Universal Terrestrial Radio Access (E-UTRA): Physical channels and modulation. April, 2009.
[10] R1-071333, E-UTRA Open Loop Transmit Diversity Performance in Correlated Channels, Motorola, 3GPP TSG RAN WG1 Meeting #47bis Sorrento, Italy, January 15 –19, 2007.
[11] RP-080599, Revised SID on LTE-Advanced, LTEAdvanced Rapporteur (NTT DOCOMO), 3GPP TSG RAN #41, Kobe, Japan,9-12 September, 2008.
[12] R1-071425, Comparison of SFBC and CDD with 2 TX and 2 Rx antennas for data channels, Alcatel-Lucent, 3GPP TSG RAN WG1 #48bis, ST.Julians, Malta, March26-30, 2007.
[13] Young-Han Nam, Lingjia Liu, and Jianzhong (Charlie) Zhang, "Phase-Shift Cyclic-Delay Diversity for MIMO OFDM Systems," International Journal of Digital Multimedia Broadcasting, vol. 2010, 2010.
[14] A. Quayum, M. Habib, M. N. Islam, F. Alam, "Cyclic Delay Diversity with Space-Frequency Coding for OFDM Systems ", in Proc. ICNEWS 2006.
[15] A. Lodhi, F. Said, A. H. Aghvami, "Cyclic delay diversity based space-time/space-frequency coded MC-CDMA syste", IEEE Vehicular Technology Magazine, September 2006
[16] Ali Alavi, Chintha Tellambura, *Senior Member, IEEE*, and Ivan Fair “PAPR Reduction of OFDM Signals Using Partial Transmit Sequence: An Optimal Approach Using Sphere Decoding” IEEE Communications Letters, Vol. 9, No. 11, November 2005.