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Research Article

PAPR Reduction Based Hybrid Selected Mapping and Partial Transfer Sequencing Techniques in MC-CDMA System

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ISSN: 2832-4463

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Submission: February 13, 2023
Published: May 12, 2023

Volume 3- Issue 1

How to cite this article: Hussain K Khleaf, Ali K Nahar*, Ansam S Jabbar and Kamarul H Bin Gazali. PAPR Reduction Based Hybrid Selected Mapping and Partial Transfer Sequencing Techniques in MC-CDMA System. COJ Rob Artificial Intel. 3(1). COJRA. 000554. 2023.
DOI: 10.31031/COJRA.2023.03.000554

Abstract

A Multi-carrier-Code-Division Multiple Access (MC-CDMA) system is a popular choice for digital data transmission over radio. However, the highest transmitted signal's Peak to Average Power Ratio (PAPR) is a major issue in MC-CDMA schemes. In this work a novel method to decrease PAPR using partial transfer sequencing technique (PTS), hybrid parallels with Selected Mapping (SLM), technique is a variation a signal scrambler that reduces the PAPR of a signal before adding it to an amplifier by using a series of multipliers, to get the best result in MC-CDMA Systems. The PTS and SLM techniques resolved convex optimization problems in choosing the best agent phase shift reduces the cost of computational complexity compared with selective mapping the traditional way. Simulation results illustration good improvement by respect of PAPR. Moreover, the proposed scheme outperforms the Selective Mapping (SLM) method, which codes 32 and 64 about 5. 23dB and 5.04dB at four and eight users respectively.

Keywords: Highest transmitted; Hybrid parallels; Hybired; Mixed results

Abbreviations: PAPR: Peak to Average Power Ratio; MC-CDMA: A Multi-Carrier-Code-Division Multiple Access; SLM: Selected Mapping; PTS: Partial Transfer Sequencing Technique; WHT: Walsh-Hadamard Transform; MCM: Multi-Carrier-Modulation; AWGN: Additive White Gaussian Noise

Introduction and Related Work

The MC-CDMA system is designed to transmit large amounts of data with high efficiency in high-bandwidth wireless communication systems. It is a transmission technique with a range of appealing properties, including high spectral efficiency, low receiver complexity, and the ability to support a great number of users, It's a strong contender for next-generation mobile radio systems [1]. Orthogonal codes are used in MC-CDMA to distribute user symbols and the frequency domain, merge them, as a consequence, each subcarrier has a low symbol rate and non-selective fading [2]. But, because of the multicarrier natures of OFDM, CDMA and MC-CDMA systems face problems caused by high PAPR harmful and useless [3]. Several approaches were suggested to decrease PAPR such as SLM, PTS and the clipping and filtering can used in Multi-carrier systems [4]. Although these techniques can be applied to MC-CDMA systems with minimal changes [5], the special structure for PAPR can be further reduced by using MC-CDMA signals. The nonlinear amplifier must operate similarly to the linear field to prevent distortion in the band and radiation outside the band, resulting in a high energy efficiency penalty and rendering the transmitters very expensive and unsuitable for low-cost applications [6]. The PTS and SLM methods require a little extra detail. Thus, it will have an effect on the transmission speed rate. Similarly, will be increased because of the complexity of multi-signal representation in together PTS and SLM. On the other hand, the selective mapping performs the best partial transfer sequencing with the same sum of side information in terms of computational complexity. Therefore, Due to the multiple representations, the BER does not generate. If the side information is lost, the BER will be modified, which is a drawback of these methods [7]. In addition, the Clipping can boost PAPR output, but it's a nonlinear process that can result in momentary, out-of-band noise reduces spectral efficiency and in-band distortion reduces BER [8]. In [9], various sequences have been examined as simulation results and phase sequences showed that the SLM method using the random sequence as a sequence of the phase is more active in decreasing the PAPR. Moreover, With the Walsh-Hadamard Transform (WHT) serving as the step sequence and Walsh-Hadamard codes serving as the spreading code, the SLM method was combined with a chosen spread code. The transmitter chooses the spreading code for each user from a list of Walsh-Hadamard codes, and the code that provides the smallest PAPR after IDFT is set for each user to minimize the performance peak power in every character of data transmitted [10]. Moreover, the [11] used a developed SLM technique with n-tuple PAPR bits as control, as well as an error control code and interleaved, to reduce PAPR in the MC-CDMA system. By making each sequence more random and reducing the possibility of in-step addition of sub-carriers, the use of this technique increases the likelihood of PAPR reduction.

Multi-Carrier-Modulation (MCM) is a commonly used transmission technique for delivering large amounts of data transmission at high speeds over a wireless channel. The MCM scheme, despite its advantages, is vulnerable to high PAPR signal transmission, which has been described as the primary challenge [12]. In [13], proposed in the literature to minimize PAPR, either by lowering peak power by using a fixed average power or changing the distribution so that the power average produced has a lower peak power. As a result, signal distortion and signal scrambling techniques are twofold types of PAPR reduction methods. PTS (Partial Transmit Sequence) is a common technique that was first introduced in [14]. As discussed in the works [15], this signal scrambling technique has a lot of potential for further research. Finally, [16] describes a detailed investigation into the manipulation of defined parameters in the additive white Gaussian noise (AWGN) channel using MC-CDMA and OFDM signals, as well as various wavelets.

In this work, an enhanced PTS method with SLM technique is proposed to improve the spreading of PAPR based on the features of the MC-CDMA systems. In addition, this innovative method achieved mixed results, by changing the phase shift to get the optimum result at the lowest possible PAPR according to the number of users and the properties of the system. The results show better performs in reduction of PAPR than both PTS and SLM methods and does not increase system complexity.

The MC-CDMA Signal's PAPR

The unique data load is multiplied by the spreading code, and formerly the distributed data chips are modulated into subcarriers orthogonal in MC-CDMA [17]. On the transmitting side of a complex data symbol for user h, (Figure 1) depicts the generation of an MC-CDMA signal. The user-specific spread code is multiplied by a^h in the data symbol transmitter.

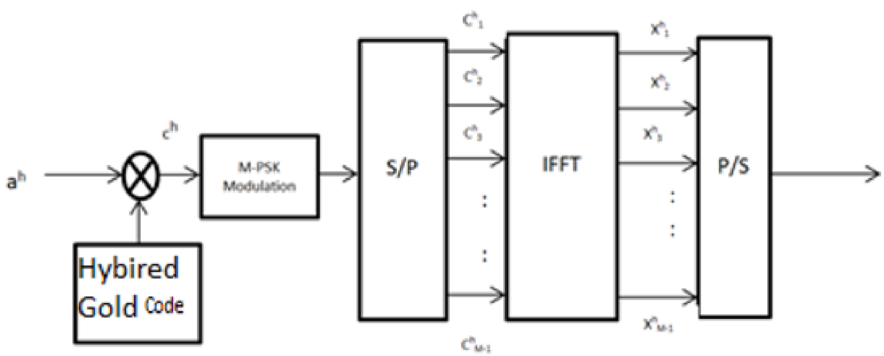


Figure 1: Transmitted side of MC-CDMA.

$$b^h = \left[b_1^h, b_2^h, \ldots, b_{M-1}^h\right]^T \quad (1)$$

where, the spread feature M.

While the codes used in this work the spread by using the Hybired Gold Code(c^h =cc_1*cc_2) obtained after coding can be given in vector scheme as:

$$c^h = a^h b^h = \left[C_1^h, C_2^h, \ldots, C_{M-1}^h\right]^T \quad (2)$$

The c^h is improved to parallel C_m^h, wherever m = 0, 1, ..., M−1, in order to get a multi-carrier, spread spectrum signal, the signal is modulated into M subcarriers and then IDFT of size N =1x M is performed. A baseband transmission signal with a time domain $x^h(t)$, for one MC-CDMA symbol after IDFT, $0 \le t \le T_s$ is:

$$x^h(t) = \sum_{m=1}^{M} \sum_{h=1}^{H} a^h b_m^h e^{j2\Pi(m-1)^t / T_s} \quad (3)$$

The symbol period for MC-CDMA is T_s, and the total number of users is H.

Then, as reference [17,18] states, PAPR can be computed for MC-CDMA signals as the ratio between the instantaneous power of the maximum signal and its average rated power $x(t)$.

$$PAPR = \frac{p_{peack}}{p_{average}} = \frac{\max_{0 \le n \le m-1}\left(|x|^2\right)}{E\left\{|x^2|\right\}} \quad (4)$$

Where P_{PEAK} denotes peak power output, Average means power output and can be calculated as:

$$P_{average} = \frac{1}{T_s}\int_0^{T_s} |x(t)|^2\, dt = \frac{1}{N}\sum_{n=0}^{N-1} E\left\{|\sum_{h=1}^{H} x^h(n)|^2\right\} \quad (5)$$

The number of subcarriers is N, and the expectation is . Similarly, on a discrete-time scale, the maximum PAPR can be expressed as follows:

$$PAPR_{\max} = 10\log_{10}(N)(dB) \quad (6)$$

One of the appearances of PAPR distribution, which has stochastic selves in MC-CDMA structures, is that it can be represented in terms of Complementary Cumulative Distribution Function (CCDF). The reference [19] is the product of this calculation. The probability of the PAPR crossing a convinced threshold is calculated as follows:

$$CCDF(PAPR) = prob\{PAPR > w\} = 1-\left(1-e^{-w}\right)^N \quad (7)$$

Proposed Method

As shown in Figure 2, the PTS-SLM method is a difference of signal scrambler that uses a series of multipliers to decrease the PAPR of a MC-CDMA signal before adding it to the amplifier. The PTS method divides a k-subcarrier set into P disjoint subcarrier subsets k_p, $p = 1,....,p$ such that $U_{p=1}^{P} k_p = k$. Formerly, PTS bargains multipliers for each subset in which the PAPR is poor.

$$\tilde{x}(t) = \sum_{P-1}^{P} b_p[P]\sum_{K\in n}^{\square} X[k]e^{i2\Pi\Delta ft} \quad (8)$$

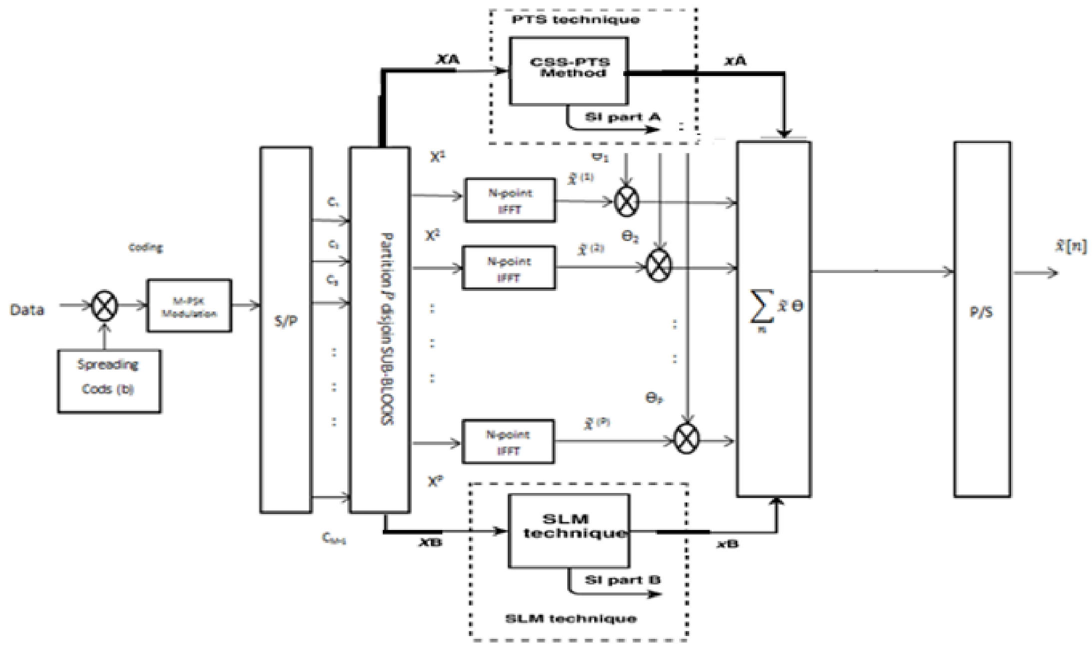


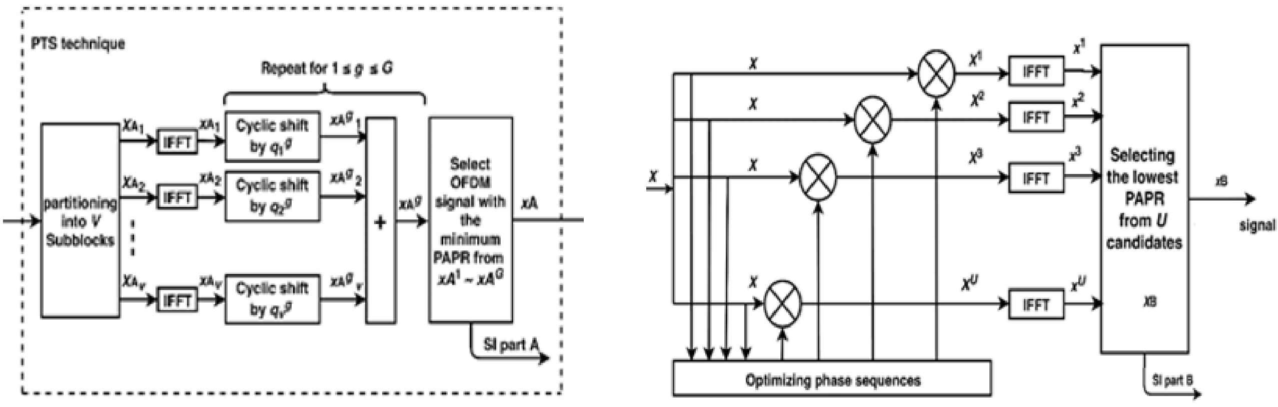
Figure 2: Block diagram of MC-CDMA based PTS-SLM PAPR reduction method.

Many studies have been conducted to decide, such as contiguous, interleaving, and random partitioning are among the strongest partitioning policies. Then, the input symbol vector is partitioned into P disjoint symbol sub-vectors $X_p = \left[X_{p,0}X_{p,1}...X_{p,N-1}\right]^T$, as follows

$$X = \sum_{p-1}^{P} X_p \quad (9)$$

(Figure 3) X_p's support sets, on the other hand, are disjoint. For each symbol sub-vector X_p, similarly known as a sub-block, should be subjected to IFFT. to construct the sub-vector $x_p = \left[x_{p,0}x_{p,1}...x_{p,N-1}\right]^T$. Then, for each sub-vector X_p, a unit magnitude constant r pslm is chosen from a list predetermined codes, that is generally Predetermined codes = 16,32 and 64. For transmission, the PAPR with the lowest value is chosen. The related parallel rotating vector's $\gamma^{w\tilde{\_}sp}$ index w is chosen using the following criteria:

$$w\tilde{\_}sp = \arg\min_{1\le w\le W} \max_{0\le n\le N-1} |\sum_{p-1}^{P}\gamma_p^{slm} x_{p,n}| \quad (10)$$



a) PTS block diagram **b) SLM block diagram**

Figure 3: Block diagram of (SLM& PTS) method based MC-CDMA.

Simulation and Result

In order the computer simulations are believed to use MATLAB to check the feasibility of the proposed process. By plotting the PAPR versus the CCDF of the PAPR, the output was calculated and compared. The PAPR reduction output is assessed using the MC-CDMA simulation parameters described in Table 1. Here, the number of sub-carriers used N=512, 1024. For each carrier, a pseudo-random partition scheme is used, as well as 64-PSK constellation mapping. The states examined the proposed, PTS- SLM parallel, algorithm by measuring the effectiveness of each (=512, M=64 PSK) parameter on the PAPR reduction, to eight users. Length code equals sixteen. If numbers Partitions P=4 Predetermined codes is 32 and 64, According to the parameters used in the last three rows of Table 1, PTS-SLM produces the best results, while PTS produces the worst, as shown in Figure 4a. While the SLM (32) and (SLM (64)) are approximately equal. In addition, Figure 4b the PAPR reduction, to sixteen users' numbers Partitions P=4 Predetermined codes is 32 and 64. Moreover, The CCDF plots of the important different methods for reducing the PAPR in MC-CDMA systems are shown in Figures 5a&b, there are shown eight and sixteen users respectively, that compares the PAPR performance of the PTS-SLM with numbers of partition eighth Predetermined codes is equal 16, 32 and 64 at the at =1024, when Modulation= 64-PSK respectively. Furthermore, Predetermined codes of selective mapping 32 and partial transfer sequencing is eight, shows the proposed mothed greatest performance about 5.7 dB 6.3dB.

Table 1: Simulation parameters for MC-CDMA.

Factors	Significance
The number of bits that are transmitted	10000
The number of Subcarriers (N)	512,1024
Users (H)	8,16
Modulation (M)	64-PSK
Additive noises	20dB
Length code	16
Spading code type	Hybired Gold code
Predetermined codes for SLM	16, 32, 64
The number of Partitions (P) for PTS	4, 8

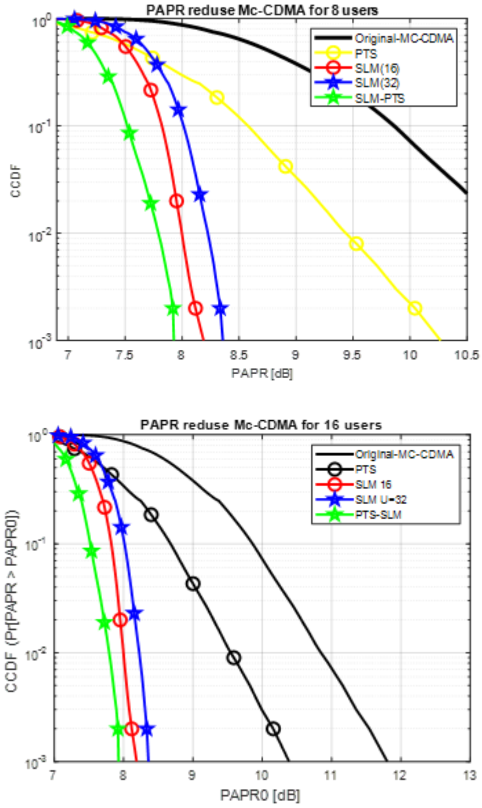


Figure 4: Effect of SLM-PTS parameters in Table 1 PAPR Reductions (a) 8 users (b) 16 users.

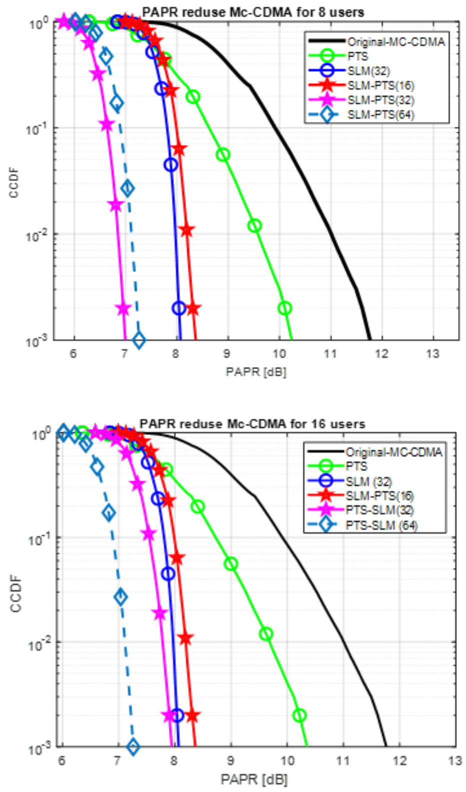


Figure 5: (a) 8 users (b) 16 users, a CCDF PTS=8, SLM Cm=32, and PTS, PTS-SLM P=8 Cm=16, 32, and 64 are compared using of the PAPR Reduction based on MC-CDMA signals.

Figure 5a shows a substantial PAPR reduction achieved by the PTS-SLM process, with nearly 7.5dB, 7.1dB, and 6.7dB reductions using Predetermined codes 16, 32 and 64 respectively. Also, similar to that estimates were the results of Figure 5b all carve except for the suggested method, we find more improvement when increasing the Predetermined codes at 64. Furthermore, The PTS-SLM technique is the strongest of all; the findings of Figures 4&5 show that the parallel PTS-SLM technique is successful in lowering PAPR significantly as compared to traditional PTS and SLM.

Conclusion

A novel PAPR reduction technique has been proposed, that is less computational complexity as compared to the alone PTS or SLM methods. An improved hybrid method as parallels between PTS and SLM to reduction PAPR based on the MC-CDMA system is offered. With its many important aspects defined based on mathematical analysis, the PTS-SLM method achieves a substantial PAPR reduction. The SLM and PTS scrambling techniques are also investigated to provide a substantial reduction in PAPR. However, the simulation results indicate that the parallel PTS-SLM method is accurate, scalable, and useful, and that the pre-defined codes and method in sections reduce PAPR the most for the MC-CDMA structure as compared to other pre-defined and composited accepted Predetermined codes.

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