Partial Transmission Sequence of Multi-Carrier Modulation

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Abstract

Partial Transmission Sequence (PTS) method proposed is one of the methods to reduce the Peak to Average Power Ratio (PAPR) of Orthogonal Frequency Division Multiplexing (OFDM) system. In which each symbol of OFDM in the frequency domain is divided into sub blocks and each one, multiplied by a phase factor to rearrange the origin symbol to a version with the lowest PAPR. This method is based on changing the phase of each sub blocks to reduce the probability of occurrence high PAPR. The nonlinear behavior of the phase affect's the accuracy of reduction which makes it different as compared with this method.

In this paper, a proposed method is suggested to reduce the complexity of such method .

Keywords :Partial Transmission Sequence, multi-carrier Modulation, Orthogonal Frequency Division Multiplexing (OFDM) system.

المستخلص

تعد طريقة الإرسال الجزئي المتسلسل (PTS) إحدى الطرائق المعتمدة لتقليل نسبة القمة إلى المعدل للقدرة في نظام التجميع المتعدد بتقسيم التردد المتعامد (OFDM). تتلخص الطريقة المذكورة بتقسيم كل رمز من رموز نظام OFDM في حيز التردد إلى مجموعات جزئية تضرب كل واحدة منها بمعامل طور الغرض منه تقليل PAPR قدر المستطاع وبذلك تكون اللبنة الأساسية لهذه الفكرة هي تقليل احتمالية حدوث الـ PAPR العالية من خلال التلاعب بأطوار المجاميع الجزئية المذكورة. السلوك اللاخطي للطور المستخدم يعمل على زيادة الدقة في تخفيض PAPR مقارنة مع السلوك الخطي المتبع بطريقة PTS التقليدية. في هذا البحث تم اقتراح طريقة لتقليل التعقيد في بناء المنظومة المذكورة.

1. Introduction

Orthogonal frequency division multiplexing (OFDM) has been receiving considerable attention for high-speed wireless communication system. One of the major drawbacks of OFDM is, however, the high peak-to-average power ratio (PAPR) of the transmission signal [1]. OFDM with high PAPR requires high linear amplifiers. Otherwise, performance degradations occur and the out-of-band power will be enhanced [1,2].

Several methods have been proposed to reduce the problem of PAPR. These methods deal with different approach's in interpretation of spurious high peaks. Partial transmission sequence (PTS) can be classified as one of the these methods. Let us consider an OFDM system with N subcarriers. Each OFDM symbol $y(n)$, consists of N complex baseband data $x_0, x_1, ..., x_{N-1}$ carried on the N subcarriers respectively. Then the OFDM signal may be represented by:- [3].

$$y(n) = \frac{1}{\sqrt{N}} \sum_{k=0}^{N-1} X_k \exp\left(2jp \frac{nk}{N}\right) \tag{1}$$

where X_k is the complex baseband data, k is index for subcarrier and n is index for the discrete time OFDM symbol.

The complementary cumulative distribution function (CCDF) of the PAPR denotes the probability that the PAPR of a data block exceeds a given threshold [4,5]. The CCDF of the PAPR of a data block is derived as:

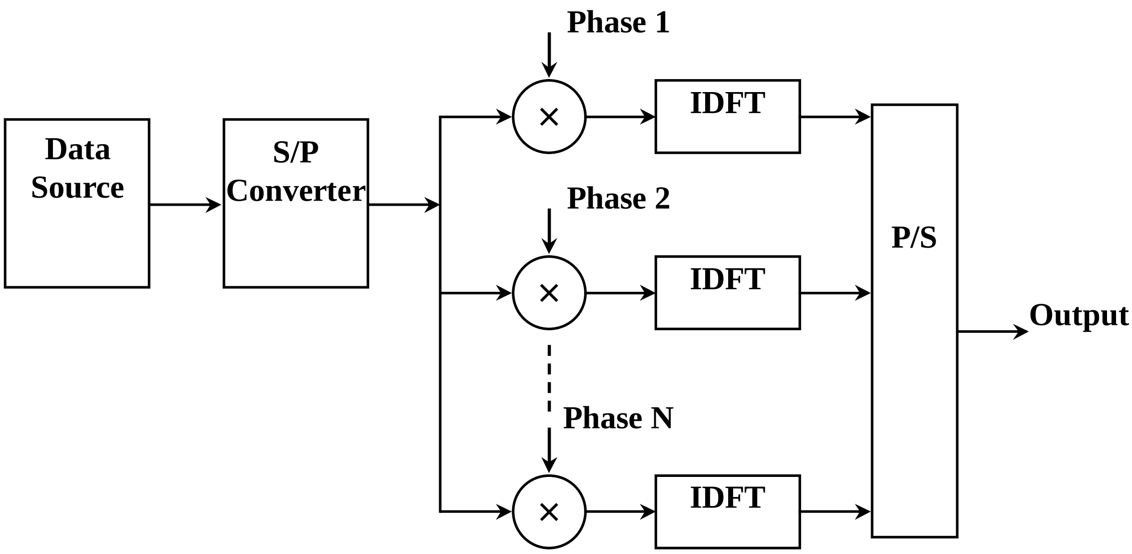
$$P(PAPR > l) = 1 - F(l) \tag{2}$$

Where l is threshold value, $F(l)$ is the cumulative distribution function (CDF).The mathematical form of the cumulative distribution of the PAPR is :

$$F(l) = (1 - \exp(l))^N \tag{3}$$

2. Partial transmission sequence method

The partial transmission sequence type is shown as in Figure (1).



Figure(1). Partial transmission sequence method.

then each sub-block of subcarriers is multiplied by a constant phase factor $\exp(jf^{(d)})$, and these phase factors are optimized to minimize the PAPR [4,6].

$$y = \sum_{d=1}^{D} IDFT\{X^{d}\} \cdot \exp\left(jf^{(d)}\right) \tag{4}$$

The phase may be calculate by the following equation [7]:-

$$\left\{f^{(d)}\right\}_{d=1}^{D} = \underset{\left[\exp\left(jf^{(1)}\right),\ldots,\exp\left(jf^{(d)}\right)\right]}{\arg\min} \left(\max \left| \sum_{d=1}^{D} IDFT\left\{X^{(d)} \cdot \exp\left(jf^{(d)}\right)\right\} \right| \right) \tag{5}$$

However, the calculated phases may reduce the peak to average power ratio as a result of increasing the average power.

3.Proposed method

The idea of this paper may be concluded by suggesting a method to calculate the phase of the partial transmission sequence this method. This method depends on the adaptation of the phase to a value which reduce the peak to average power ratio. Firstly the phases are assumed to have constant values and according to the peak to average power ratio, the phase values are changed. The deference between the peak to average power ratio in $i^{th}$and $(i+1)^{th}$ iteration represents the error signal, then the phase values are taken to reduce this error signal.

4. Results

Computer simulation tests have been taken to show the performance of the traditional and the suggested method in these test, the number of subcarrier(N) are assumed to have a values of 16 and 32. Figure(2) shows the performance of the suggested system for N=16, while Figure (3) shows the performance for N=32. The value of the peak to average power ratio of the traditional and the suggested methods are shown in Table (1) and Table (2). Table (1) shows the PAPR for N=16 while Table (2) shows the PAPR for N=32.

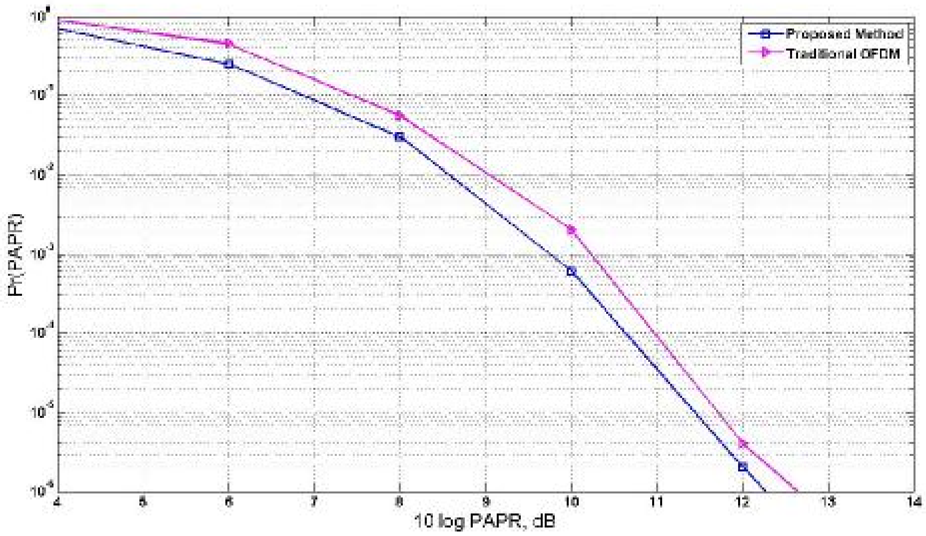


Figure (2). Performance of traditional and suggested systems for N=16.

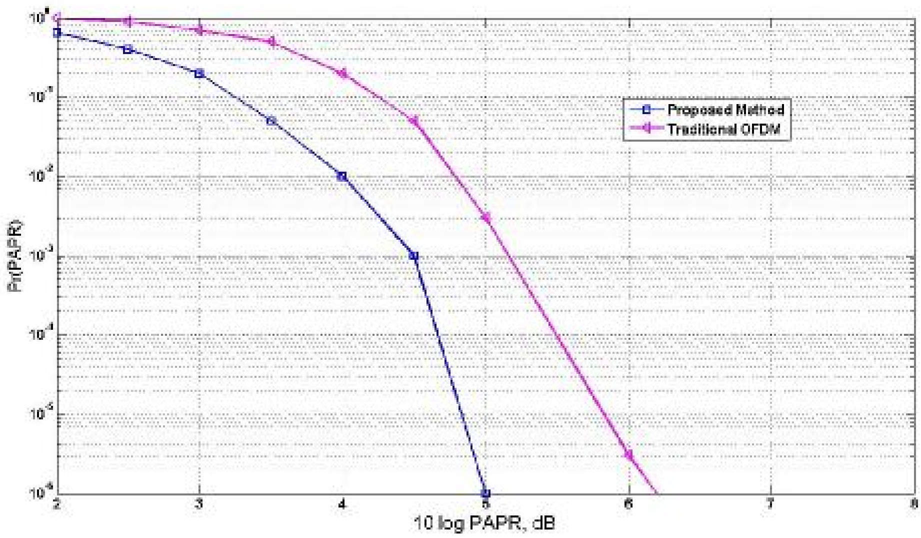


Figure (3). Performance of traditional and suggested systems for N=32.

Table (1). Peak to average power ratio for the traditional and suggested system N=16.

Traditional	11.0412	10.4999	9.463	7.8224	3.4484
Proposed	4.3329	3.9959	3.6771	2.9224	1.185

Table(2). Peak to average power ratio for the traditional and suggested system N=32.

Traditional	12.2736	11.9142	8.0309	6.9588	6.7263
Simulated	5.4223	5.1278	3.8416	3.6376	3.4401

5. Conclusions

In this paper, a method for calculating the phase of partial transmission sequence of the multicarrier modulation system is suggested. The performance of the suggested method shows the ability of the system to reduce the PAPR as shown in Tables (1) and (2) with acceptable performance as shown in Figures (1) and (2). The phase of the partial transmission sequence is calculated according to the error signal for two iterations of the peak to average power ratio of the output signal.

6.References

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