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A Novel Papr Reduction Approach Based On The Weighted OFDM Algorithm

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Abstract

Although tremendous progress has been made in the area of wireless communications based on orthogonal frequency division multiplexing but still there exist some problems. In literature so many works has been reported to resolve the issues but still Peak to average power ratio is still area of concern. In this paper, instead of spectral efficiency we make use of HPA (high power amplifier) weights to resolve the issue of Peak to average power ratio. Meanwhile, the time period required to transmit the weighted OFDM signal is that the same because the time period for the first OFDM signal. The performance of the proposed scheme is estimated with Mat lab Simulator. With respect to the theoretical analysis, the weighted OFDM signal PAPR is smaller than that of the clipping and filtering (C&F) methodology, and also the bit-error-rate (BER) performance of the weighted OFDM system is improved compared with the C&F methodology. Here, the projected methodology is easier than the C&F method.

KEY TERMS: OFDM, HPA, PAPR, BER

I. INTRODUCTION

ORTHOGONAL frequency division multiplexing (OFDM) systems have been extensively applied in wireless communication systems, e.g. Worldwide Interoperability for Microwave Access (Wi MAX). It is widely known that OFDM is an attractive technique for achieving high data transmission rate in wireless communication systems and it is robust to the frequency selective fading channels [1] OFDM systems have one major disadvantage, i.e. a very high Peak-to-Average Power Ratio (PAPR) at the transmitter [2] which causes signal distortion such as in-band distortion and out-of band radiation due to the nonlinearity of the high power amplifier (HPA) and a worse bit error rate (BER) [3].

To reduce the distortions caused by the nonlinearity of HPA it requires a large back off from the peak power which is a significant burden, especially in mobile terminals the large PAPR increases the complexity of analog-to-digital converter (ADC) and digital-to-analog converter (DAC). Thus, PAPR reduction is one of the major problems in OFDM systems. PAPR reduction schemes can be classified according to several criteria. First, with respect to the computational operation in the frequency domain the PAPR schemes can be categorized as multiplicative and additive schemes tone reservation (TR) [5], peak canceling, and clipping [6] are additive schemes, because peak reduction vectors are added to the input symbol vector.

On the other hand, Selected mapping (SLM) and partial transmit sequences (PTS) are examples of the multiplicative scheme because the phase sequences are multiplied by the input symbol vectors in the frequency domain [4]. Second, the PAPR reduction schemes can be also categorized based on whether they are deterministic or probabilistic. Deterministic schemes, such as peak canceling, clipping Probabilistic schemes, however, statistically improve the characteristics of the PAPR distribution of the OFDM signals avoiding signal distortion. SLM and PTS are examples of the probabilistic scheme because several candidate signals are generated and that which has the minimum PAPR is selected for transmission.

In this paper, we propose a new NCT algorithm which transforms the Gaussian distributed signal into a desirable distribution form defined by a linear piecewise function with an inflexion point. Compared to the previous methods, this algorithm will choose the proper transform parameters to reduce the impact of Companding distortion on the BER performance.

In addition, it also allows more flexibility and freedom in the Companding form to satisfy various design requirements. The results regarding the achievable reduction in PAPR, signal attenuation factor, and the selection criteria of transform parameters are derived and verified through computer simulations.

II. PROPOSED METHOD

Orthogonal multicarrier modulation is Associate in nursing economical methodology of information transmission over channels with frequency-selective weakening. This method includes a comparatively straightforward implementation supported the inverse fast Fourier remodel (IFFT). The simplified block diagrams for Associate in Nursing OFDM system with the convolution theme and also the projected weighted theme as shown in Fig. 1. As delineated in Fig. 1(a), the modulated information stream is carried on the multi carriers by the IFFT, and also the convolution block reduces the PAPR of signal, that is love the load block of the proposed theme, as shown in Fig. 1(b). within the following block, the cyclic prefix is another before the HPA For a discrete data $\{ak\}_{k=0}^{N-1}$ multicarrier modulated signal X_N(t) on [0,NT] is represented by

$$x_N^{(t)} = \frac{1}{\sqrt{N}} \sum_{k=0}^{N-1} a_k e^{j2\pi f_{kt}} \qquad (1)$$

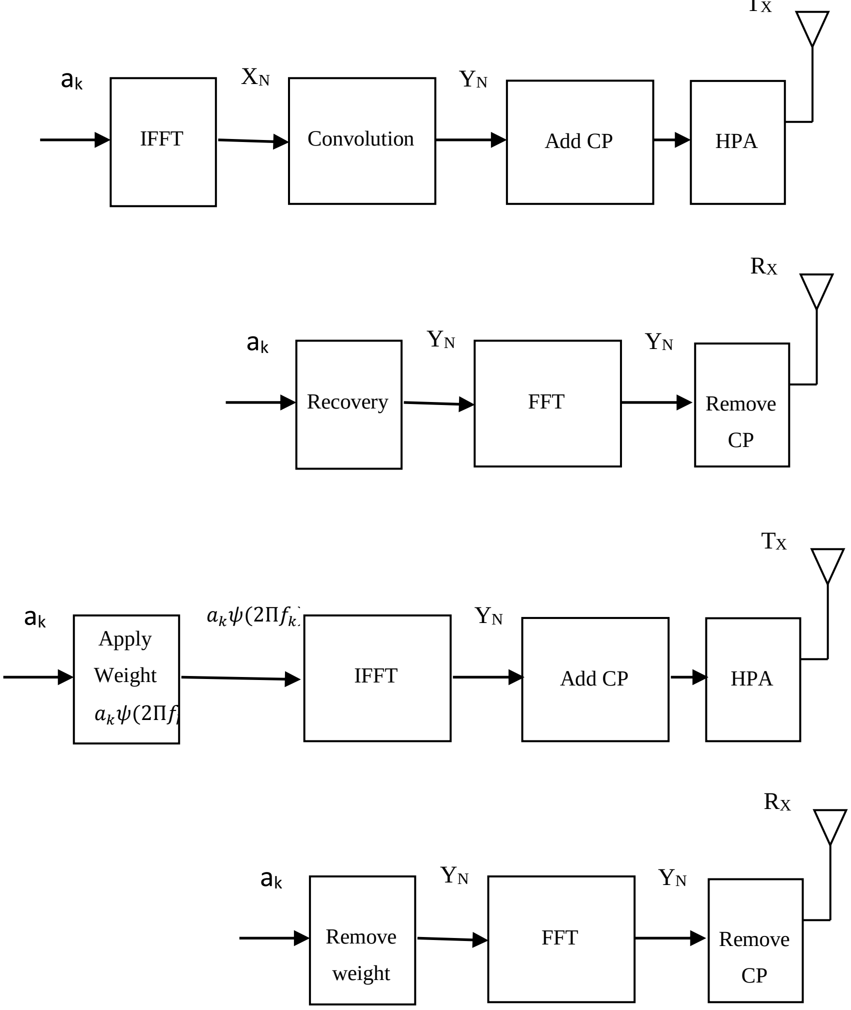

Figure 1: Simplified block diagrams for an OFDM system with (a) convolution scheme and (b) proposed weighting scheme.

The PAPR of x_N over the time interval [0,NT] is defined by

$$APR(x_N) = \frac{max 0 \le t \le N_T |x_N(t)|^2}{E(|x_N(t)|2)} \qquad (2)$$

Where E (·) denotes the expectation operator.

First, we consider the convolution method and then derive the corresponding weighted OFDM signal

A. Convolution Method

The Fourier transform

$$f|f|(\xi) = \int f(x) e^{-j\xi x}\, dx \qquad (3)$$

If the integral exists. The inverse Fourier transform $f^{-1}[F]$ of f defined by

$$f^{-1}[F](x) = \frac{1}{2\pi}\int F(\xi)\, e^{j\xi x} dx \qquad (4)$$

Provided that the integral exists. Then $f^{-1}[F](f) = f$, when f and F[f] are integrable, and

$$F\big[f[f]\big] = 2\pi f \qquad (5)$$

whereˇ

f(x)=f(−x).

We consider signal ϕ as

$$\varphi(x) = \frac{1-sinc(x)}{\pi^2 x^2} \qquad (6)$$

Where

$$sinc\ x = \begin{cases} \frac{sin\pi x}{\pi x}, & x \neq 0 \\ 1, & x = 0 \end{cases}$$

By direct computation, the Fourier transform Φ:=F[ϕ]of ϕ is given by

$$\varphi(\xi) = \begin{cases} \frac{1}{2}\left(1 - \frac{|\xi|}{\pi}\right)^2, & |\xi| \le \pi \\ 0, & otherwise \end{cases}$$

The signal is a band limited signal with band width π, has no zero on the real line, and

$$\varphi = \varphi \qquad (7)$$

For more information about ϕ, see the Appendix at the end of this paper. Consider the circular convoluted signal as follows:

$y_N = \frac{1}{2\pi} x_N * \varphi(t) = \int_{-\pi}^{\pi} x_N(t-\xi)\phi(\xi)\, dx$

(8)

Taking the Fourier transform in (8), we have by (5) and (7) that

$F|y_N| = \frac{1}{2\pi} F|x_N|f|\phi| = F[x_N]\varphi$

(9)

Where

$a_k = \frac{\sqrt{N}\ \ F[x_N](2\pi f_k)}{2\pi} =$

$\frac{\sqrt{N}\ \ F[x_N](2\pi f_k)}{2\pi\varphi(2\pi f_k)}$ (10)

B. Weighted OFDM System

We show that the convoluted signal in (8) can be written as a simple weighted OFDM signal in. Observing by (5), (7) and (8) that

$$\int_{-\pi}^{\pi} e^{j2\pi f_k(t-\xi)\phi(\xi)}\, d\xi = 2\pi\phi(2\pi f_k)e^{j2\pi f_k t}$$

$y_N(t) = \frac{1}{\sqrt{N}} \sum_{k=0}^{N-1} a_k \varphi(2\pi f_k)\, e^{j2\pi f_k t} \quad 0 \le t \le$

Nt (11)

the convoluted signal in (8) can be expressed as the following weighted OFDM signal:

$\varphi_\alpha^{(x)} = \varphi(x) + \frac{\alpha}{\log N}$ (12)

C. Weighted OFDM System With Modified Weight

The demerit of the weighted OFDM signal in (11) is the degradation of BER performance since the weightϕis nonuniform. To overcome this obstacle, we consider the modified weight with a positive constant α as follows:

$z_N(t) = \frac{1}{\sqrt{N}} \sum_{k=0}^{N-1} a_k \varphi(2\pi f_k)\, e^{j2\pi f_k t} \quad 0 \le$

$t \le NT$ (13)

whereαis a shift parameter, and logN obtained by experiment. Then,ϕ=ϕ0. In the weighted OFDM signal in (11), we replace weight ϕ with ϕα for a suitable positive constantαto get the weighted OFDM signal, i.e.,

$z_N(t) = \frac{1}{\sqrt{N}} \sum_{k=0}^{N-1} a_k \varphi(2\pi f_k)\, e^{j2\pi f_k t} \quad 0 \le t \le$

NT

as a transmitted signal instead of xN in (1)

The PAPR of the weighted OFDM signalzNis given by

$PAPR(z_N) = \frac{max0\le t \le N_T|z_N(t)|2}{E(z_N(t)^2)}$ (14)

In the following, we provide the simulation results showing that the PAPR of the weighted OFDM signal with modified weight ϕαis smaller than that of the C&F method (see Fig. 2), and the BER performance of the weighted OFDM system with modified weight ϕ α is improved compared with the C&F method (Fig. 3). We note that as increases, due to the modification of weight, the BER performances improved, whereas the complementary cumulative distribution function (CCDF) grows slightly. In (13), we can recover discrete data {ak ϕα (2πfk)}N−1k=0 by the conventional method of the OFDM system. Since by dividing the given discrete data by (2πfk) we can obtain the original discrete data, the weighted OFDM system is not expected to cause any computational complexity in recovering the original discrete data. In fact, 2Ncomplex multiplications are additionally needed compared with the original OFDM method. We note that a sufficient condition for a signal˜ ϕto be a proper weight is that˜ ϕ(2πfk)=0foranyk=0,...,N−1.

III. SIMULATION RESULTS

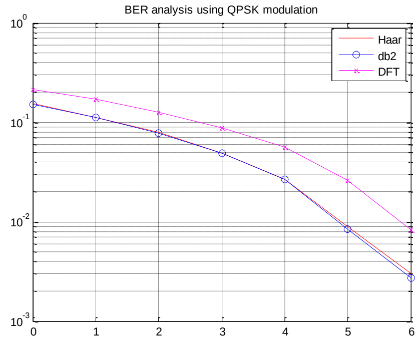

Figure 1: BER analysis using QPSK modulation

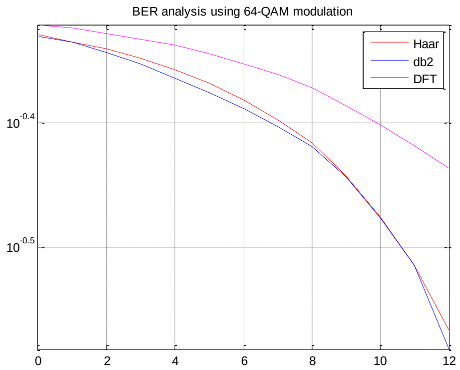

Figure 2: BER analysis using 64-QAM modulation

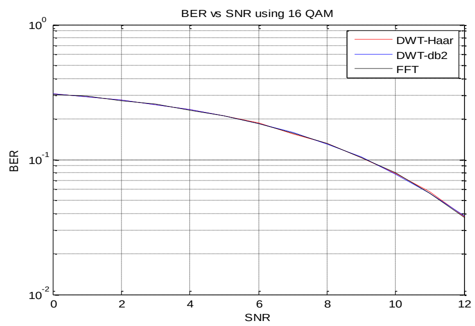

Figure 3: BER vs SNR using 16-QAM modulation

IV. CONCLUSION

A PAPR reduction theme supported a weighted OFDM signal has been projected to cut back the PAPR while not information distortion in removing the burden at the receiver facet within the mathematical read. To reduce the height of the OFDM signal, a band limited signal ϕ, which is not zero on the set N−1k=0, is introduced, and that we kind weight ϕα=ϕ+α/logN for an acceptable positive constant α. we tend to contemplate a weighted separate information to make a weighted OFDM signal, before the HPA, wherever the weights area unit obligatory by mistreatment signal ϕα It is shown that the PAPR of this weighted OFDM methodology is smaller than that of the C& amp; F methodology, and also the performance of BER also improved compared with the C& amp; F methodology Which is outlined on an equivalent interval because the original OFDM signal, before the HPA, wherever the weights area unit obligatory by mistreatment signals ϕα? It is shown that the PAPR of this weighted OFDM methodology is smaller than that of the C& amp; F methodology, and also the performance of BER also improved compared with the C& amp; F methodology.

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