Research Paper Engineering

A Review Paper on: the Papr Analysis of Orthogonal Frequency Division Multiplexing (OFDM) Using Clipping With Chaotic Sequence

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ABSTRACT

An OFDM, a multicarrier system is used to increase system robustness against frequency selective channels. It has many advantages such as it is used to combat the ISI and narrowband interference, it reduces the complexity of equalizers used in high data rate applications. However significant disadvantage of OFDM is that, it has relatively high PAPR. To reduce the effect of PAPR many techniques have been introduced e.g. Clipping, SLM, PTS, Coding & Pre-coding etc. Each technique has its own benefits along with certain drawbacks. In this paper, various PAPR reduction techniques were studied and effect of clipping with chaotic sequence has been analyzed.

KEYWORDS PAPR, OFDM, Chaotic sequence

I. INTRODUCTION

The orthogonal frequency division multiplexing (OFDM) is a wideband wireless digital communication technique that is based on block modulation. The OFDM is a digital modulation scheme that can support high speed video communication along with audio with elimination of ISI and ICI. At the same time, it can accommodate more number of users showing the spectral efficiency. It is a multiplexing /multiple access schemes that have many favorable features required for the fourth generation wireless communication systems. Opposite to these advantages, the major drawback of OFDM system is its large peak-to-average power ratio (PAPR)[1,2,3]. Unfortunately, the higher value of PAPR inherent by the signals envelopes will occasionally drive high power amplifiers (HPAs) to operate in the nonlinear region. The nonlinearity of the HPA exhibits amplitude and phase distortions, which cause loss of orthogonality among the subcarriers (SCs), and hence, inter-carrier interference (ICI) is introduced in the transmitted signal. The ICI power is proportional to the amplitude of the signal at the amplifier input and it may cause a considerable bit error rate (BER) degradation

To overcome above mentioned serious drawbacks, several technique have been proposed, such as Signal companding methods have low-complexity, good distortion and spectral properties; however, they have limited PAPR reduction capabilities. Other advanced techniques such as coding, partial transmit sequences (PTS) and selected mapping (SLM) have also been considered for PAPR reduction. Such techniques are efficient and distortion less, nevertheless, their computational complexity is high and requires the transmission of several side information (SI) bits. Thus, make the system cumbersome.

In this paper, we focus on the Clipping technique with chaotic sequence for PAPR reduction. The proposed chaotic based clipping scheme is advantageous in terms of secure communications.

II. OFDM SYSTEM DESCRIPTION

The OFDM is a wideband wireless digital communication technique that is based on block modulation. The transmitter and receiver of an OFDM systems must be carefully designed so that orthogonality can be maintained between the subchannels. As the number of subcarriers increases, implementation of an OFDM system becomes more complex considering the requirements of modulation, synchronization and coherent demodulation.

Figure 1 shows a block diagram for an OFDM transmitter. The first step is to divide the data stream using serial to parallel process into a number of sub streams (the number of subcarriers), let it be equal to N. Then, N-point inverse fast Fourier transform (IFFT) is used to convert the samples into the discrete-time domain. After that, a parallel to serial process is applied on the resulting discrete-time domain points. Then a guard interval which is called cyclic prefix (CP) is appended to the sequence. The CP is used to mitigate the ISI resulted from the channel delay spread. The OFDM complex envelope is obtained by passing the sequence through a digital-to-analog converter (DAC). Then the analog in-phase, I and quadrature-phase Q signals are up converted to the RF carrier frequency for transmission.

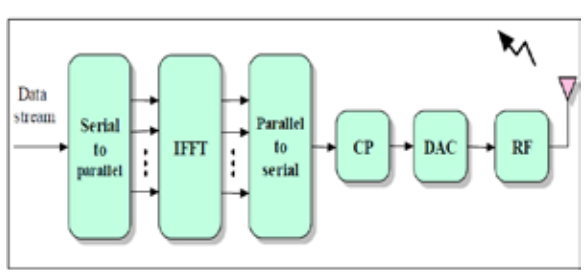

Figure 1: Block Diagram of OFDM Transmitter

In OFDM receiver shown in figure 2 the inverse operations with respect to transmitter are performed. First of all, the received signal is down-converted. Then, analog-to-digital converter (ADC) is applied to perform the analog to digital conversion, and then the guard interval is removed. After that, a serial to parallel operation is performed on the resultant sequence. Then, the resulted points are passed through Fast Fourier transform (FFT) to get the sub-streams. These substreams are given as an input to a parallel to serial process to get the overall transmitted stream.

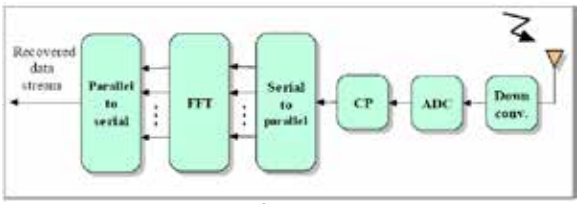

Figure 2: Block Diagram of OFDM receiver.

III PEAK TO AVERAGE POWER RATIO

Presence of large number of independently modulated sub-carriers in an OFDM system the peak value of the system can be very high as compared to the average of the whole system. This ratio of the peak to average power value is termed as Peak to Average Power Ratio (PAPR)

$$PAPR = \frac{Maximum\ Peak\ Power\ of\ input\ signal}{Average\ Power\ of\ input\ signal}$$

IV CHAOTIC SEQUENCE

The word Chaos implies a state of disorder and irregularity. It describes many physical phenomena with complex behaviour by simple laws. The dynamical systems mean systems that develop in time in a non-trivial manner 4,5,6. Deterministic chaos is an irregular motion generated by nonlinear dynamical systems whose laws determine the time evolution of a state of the system from knowledge of its previous history Recently, chaotic sequences have been adopted instead of random ones and very interesting results have been shown in many applications such as secure transmission , natural phenomena modeling , neural networks, and nonlinear circuits . Also in, chaotic time series were used in DNA computing procedures. The choice of chaotic sequences is justified theoretically by their unpredictability, i.e., by their spread-spectrum characteristic.

Definition of a chaotic map:Let A be a set. A function f: A→A is called chaotic on A if:

1) f has sensitive dependence on initial conditions.
2) f is topologically transitive.
3) Periodic points are dense in A.

Properties of a chaotic function

1) Unpredictability

A function f: A→A has sensitive dependence on initial conditions if there exists $\delta > 0$ such that, for any $x \in A$ and any neighbourhood N of x, there exists $y \in N$ and $n \geq 0$ such that $|f^n(x) - f^n(y)| > \delta$.

Intuition: For each point x there is at least one point y in any neighbourhood of it, which will eventually separate from x by a distance of at least δ after a certain number n of iterations of the function.

2) Indecomposability

A function f : A→A is said to be topologically transitive if for any pair of open sets B, $C \subset A$ there exists $k > 0$ such that $f^k(B) \cap C \neq \emptyset$.

Intuition: Points belonging to an arbitrarily small neighbourhood will eventually move to any other neighbourhood after a certain number of iterations

3) Element of regularity

The point x is a fixed point for if f (x) =x. The point x is a periodic point of period n if $f^n(x) = x$. The least positive integer n for which $f^n(x) = x$ is called the prime period of x.

Intuition: There are points in set A that are finally mapped onto them after a number of iterations. When these points are dense in set A, an element of regularity is introduced.

V. AWGN Channel

Additive White Gaussian Noise (AWGN) is a **channel model in which the only impairment to communication is a linear addition of wideband or white noise with a constant spectral density expressed as watts/Hz of bandwidth and a Gaussian distribution of amplitude. An AWGN channel** adds white Gaussian noise to the signal that passes through it. The relative power of noise in an AWGN channel is typically described by quantities such as:

i. Signal-to-noise ratio (SNR) per sample. This is the actual input parameter to the `awgn` function.
ii. Ratio of bit energy to noise power spectral density (Eb/No). This quantity is used by BER Tool and performance evaluation functions in this toolbox.
iii) Ratio of symbol energy to noise power spectral density (Es/No)

VI. CONCLUSIONS

In this paper,study of performance of chaotic communication based OFDM system is done. The use of chaotic communication system can increase the security prospective of the system due to it bifurcation behavior when varying the initial condition. The proposed scheme performance can be evaluated using AWGN channel. BER performance of the system is also improved with adaptive modulation using BPSK, QPSK and QAM modulation as per their performance. Future extension of this work has a lot of scope as noted. The proposed system is used with 2-order chaotic communication structure. It can further extend for 3-order chaotic communication structure.

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