PAPR Reduction for OFDM Signal by Using Different Method: Review

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Abstract

Orthogonal Frequency Division Multiplexing (OFDM) is widely used in contemporary communication systems for its good robustness in multi path environment. One of the drawbacks of the OFDM transmitters is high Peak to Average Power Ratio (PAPR) of OFDM signals. The maximal value of the PAPR grows with logarithm of number of subcarriers. Orthogonal Frequency Division Multiplexing (OFDM) has significant ability to support high data rates for wide area coverage, robustness to multipath fading, immunity to major drawbacks of OFDM signal is its large envelope fluctuation, likely resulting in large peak-to-average power ratio (PAPR), which distorts the signal if the transmitter contains the non linear components such as power amplifiers and these may causes deficiencies such as inter modulation, spectral spreading and change in signal constellation.

Keywords: PAPR, OFDM.

1. INTRODUCTION

1.1 Companding Technique

There are numerous benefits associated with OFDM systems. One of them is its high spectral efficiency due to the minimum spectral spacing between the subcarriers, attributed to their orthogonality. Also adaptive modulation schemes can be used on individual subcarriers, according to the transmission conditions on each subcarrier. Minimizing PAPR allows higher Average power to be transmitted for a fixed peak power and improving the overall signal to noise ratio at the receiver. Some of the methods proposed in literature to reduce the PAPR of OFDM signals include several techniques such as amplitude clipping ,tone reservation(TR), active constellation extension(ACE) and coding [1,2], selective mapping [3], partial transmitting . In [5], optimal companding coefficient is determined to enlarge small OFDM signals along with PAPR reduction. In [6], non-linear companding scheme is described y a single valued function which allows to be transformed before amplification. Further this multicarrier transmission system can be implemented in the digital domain by using computationally efficient IFFT. Despite its multidimensional benefits of OFDM systems suffer however from a number of drawbacks. [8,9] However, one major drawback is its high peak to average power ratio (PAPR) resulting in nonlinear distortion and degradation of bit error rate (BER) at the output of high power amplifier. The most straightforward way of mitigating this problem is to introduce an amplifier back-off, which provides sufficient head -room for the high modulated signal peaks to be amplified in the linear region. Of course, large amount of back-off results in a significant penalty in terms of the power efficiency. Therefore, an attractive solution for a cost effective system is to reduce PAPR of OFDM signals.

2. FFT/IFFT

A general digital communication system blocks. The A/D converter being used to convert the analog source to the digital i.e. in the form of binary sequences.[5] The source encoding takes place to compress the transmitted digital data up to an extent such that it can be received without any loss. There are some basic source coding techniques are available like the Hoffman coding and Shannon-Fano coding. The channel encoders add redundant bits to the information sequence from the received signal for the reliable communication. In this section we propose a new technique based on modifying the FFT/IFFT matrices. Using the modified matrix, the maximum and minimum of the time domain signal is replaced by the linear combination of them. In this method, peak of the signal will be reduced while the average is kept constant. In the following, the new matrix and its inverse form are introduced.[7] This method will require transmission of some extra information form transmitter to the receiver, which will be addressed in the next section. In the last subsection of this section we will consider some implementation issues which make the design simpler.

The proposed method overcomes the drawback of the conventional method when successive peaks emerge within a half of the window size. The clipping method is the simplest way to reduce PAPR. However, it distorts signals nonlinearily and significantly increases the out-of-band radiation. A different approach is to multiply large signal peaks with a certain window function. In order to maintain the out-of-band radiation within a certain level, it is benefit to increase the window length.
3. OFDM: DISCUSSION

Orthogonal frequency division multiplexing (OFDM) [5],[6] transmission scheme is a type of multichannel system which avoids the usages of the oscillators and band limited filters for each subchannel. The OFDM technology was first conceptualized in the 1960s and 1970s. The main idea behind the OFDM is that since low-rate modulations are less sensitive to multipath, the better way is to send a number of low rate streams in parallel than sending one high rate waveform. It divides the frequency spectrum into sub-bands small enough so that the channel effects are constant (flat) over a given sub-band. Consumes lots of excess resources than the original OFDM system in which the matrices $T_1, T_2, \ldots, T_n$ are replaced with IFFT and FFT matrices. At the first glance it is true since matrix $T$ may change from symbol to symbol. To have a less complex design in the transmitter, it would be wise to replace the $T$ matrix block in the transmitter with an IFFT block and a post-processor block.

4. TRANSMITTER PAPR

The linear power amplifiers are being used in the transmitter so the Q-point must be in the linear region. Due to the high PAPR the Q-point moves to the saturation region hence the clipping of signal peaks takes place which generates in-band and out-of band distortion. The frequency domain error signal is passed through the block ensuring the in band bounded distortion (BD) after the multiplication with constant. The real and the imaginary parts of the error signal are separately treated and limited to a predefined constant $D$, irrespective of the symbols sent on a particular subcarriers. Some other possible methods are also there in order to reduce the distortion with a bounded predefined constant[10]. The error signal with bounded distortion is then subtracted from the original signal where both of these signals are in the frequency domain.

5. ADVANTAGES & DISADVANTAGES

Another disadvantage of this technique is its high complexity due to presence of a lot of IFFT blocks before selecting a particular OFDM signal. Here a method being proposed to generate a random matrix from the existing phase matrix of the classical SLM technique which fulfills the criteria that the new matrix has less number of rows than that of the existing matrix.

The primary advantage of OFDM over single-carrier schemes is its ability to cope with severe channel conditions (for example, attenuation of high frequencies in a long copper wire, narrowband interference and frequency-selective fading due to multipath) without complex equalization filters. Channel equalization is simplified because OFDM may be viewed as using many slowly modulated narrowband signals rather than one rapidly modulated wideband signal. The low symbol rate makes the use of a guard interval between symbols affordable, making it possible to eliminate inter symbol interference (ISI) and utilize echoes and time-spreading (on analogue TV these are visible as ghosting and blurring, respectively) to achieve a diversity gain, i.e. a signal-to-noise ratio improvement. This mechanism also facilitates the design of single frequency networks (SFNs), where several adjacent transmitters send the same signal simultaneously at the same frequency, as the signals from multiple distant transmitters may be combined constructively, rather than interfering as would typically occur in a traditional single-carrier system.

6. STUDY & REVIEW

In the adaptive symbol selection scheme [3], P signals containing the same information are created from the input data and the variant with the smallest PAPR is selected for transmission. It is possible to create these variants using P−1 inter leavers followed by constellation mapping and Inverse Fast Fourier Transform (IFFT) Note that a side information about the path with lowest PAPR has to be sent over channel complex multiplications [6].

7. CONCLUSIONS

Among the various PAPR reduction techniques, companding appears attractive for its simplicity and effectiveness. In this paper novel companding technique based on mathematical airy function is proposed which offers improved bit error rate, minimizes out of and interference and reduce PAPR effectively. Simulation results illustrates the performance of the system under Additive White Gaussian Noise (AWGN) and further evaluation is done for comparing the proposed companding technique with previous techniques This proposed scheme has an additional advantage of avoiding the extra SI index along with the OFDM signal.

8. REFERENCES


