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PEAK-TO-AVERAGE POWER RATIO REDUCTION IN OFDM SYSTEM THROUGH CODING TECHNIQUE USING RAYLEIGH CHANNEL

SNEHAL B. MESHRAM, S. V. RATHKANTHIWAR

Department of Electronics Engineering, Yashwantrao Chavan College of Engg. Nagpur

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Corresponding Author

Ms. Snehal B. Meshram

Abstract

One of the challenging issues for Orthogonal Frequency Division Multiplexing (OFDM) system is its high Peak-to-Average Power Ratio (PAPR). In this paper, we review and analysis different OFDM PAPR reduction techniques, based on computational complexity, bandwidth expansion, spectral spillage and performance The sub-block complement coding (SBCC) complement block coding (CBC), cyclic coding (CC), simple block coding (SBC), modified simple block coding (MSBC) and simple odd parity code (SOPC) are the codes in which there is PAPR Reduction but the problem with this codes is in the limitation of frame size. But under the same coding rate, the PAPR reduction obtained by using Sub band coding is better than the rest schemes. The flexibility on choosing the coding rate and low complexity makes that the proposed scheme Sub band coding is more suitable for the large frame size with high coding rate and can provide error detection. We also discuss some methods of PAPR Reduction.

I. INTRODUCTION

Wireless digital communication is rapidly expanding resulting in a demand for wireless systems that have high data rate communication and has been deployed in many standards. OFDM is one of the MCM which offers high spectral efficiency, multipath delay speed tolerance, immunity to freq selective fading channels and power efficiency**.**

With the rapid growth of digital communication in recent years, the need for high-speed data transmission has increased. The mobile telecommunications industry faces the problem of providing the technology that be able to support a variety of services ranging from voice communication with a bit rate of a few kbps to wireless Multimedia in which bit rate up to 2 Mbps. Many systems have been proposed and OFDM system based has gained much attention for different reasons. Although OFDM was first developed in the 1960s, only recently has it been recognized as an outstanding method for high-speed cellular data communication where its implementation relies on very high-speed digital signal processing, and this has only recently become available with reasonable prices of hardware implementation.

CODING:

A simple block coding scheme was introduced by Jones *etal.* [3], and its basic idea is that mapping 3 bits data into 4 bits codeword by adding a Simple Odd Parity Code (SOBC) at the last bit across the channels. The main disadvantage of SOBC method is that it can reduce PAPR for a 4-bit codeword. Later, Wulich applied the Cyclic Coding (CC) to reduce the PAPR [11]. In 1998, Fragia como proposed an efficient Simple Block Code (SBC) to reduce the PAPR of OFDM signals [12].

However, it is concluded that SBC is not effective when the frame size is large. Subsequently, Complement Block Coding (CBC) and Modified Complement Block Coding (MCBC) schemes were proposed to reduce the PAPR without the restriction off rame size [13], [14]. CBC and MCBC are more attractive due to their flexibility on choosing the coding rate, frame size and low implementation complexity. CBC and

MCBC utilize the complementary bits that are added to the original information bits to reduce the probability of the peak signals occurrence.

In [15], [16], [18], authors used the Golay complementary sequences to achieve the PAPR reduction, in which more than3-dB PAPR reduction had been obtained. Codes with error correcting capabilities has been proposed in [17] to achieve more lower PAPR for OFDM signals by determining the relationship of the cosets of Reed-Muller codes to Golay complementary sequences. While these block codes reduce PAPR, they also reduce the transmission rate, significantly for OFDM systems with large number of subcarriers.

Even if it is possible, the complexity is still too high. Based on this motivates, authors of [19] proposed a novel method of computation and reduction of the PAPR and it mainly introduced a specific phase shift to each coordinate of all possible code words where phase shifts are independent of the code words and known both to transceiver, then it can be freely obtained more 4.5-dB PAPR reduction by using the optimized phase shifts. From this viewpoint, we also consider the coding scheme of PAPR reduction as a special phase optimization.

In summarization, the inherent error control capability and simplicity of implementation make coding method more promising for practical OFDM systems design. However, the main disadvantage of this method is the good performance of the PAPR reduction at the cost of coding rate loss.

2. SUB-BAND CODING:

In this Coding, the image is decomposed into set of Bands called sub-bands which are used in re-assembling to reconstruct the original image.

DWT Signal is calculated by passing through filter. First samples are passed through low pass filter. with impulse response g resulting in a convolution of the two:

$$y[n] = (x * g)[n] = \sum_{k=-\infty}^{\infty} x[k]g[n-k].$$

The signal is also decomposed simultaneously using a high-pass filter h. The outputs giving the detail coefficients (from the high-pass filter) and approximation coefficients (from the low-pass). It is important that the two filters are related to each other and they are known as a quadrature mirror filter.

However, since half the frequencies of the signal have now been removed, half the samples can be discarded according to Nyquist's rule. The filter outputs are then subsampled by 2 (Mallat's and the common notation is the opposite, g- high pass and h-low pass)

$$y_{\mathrm{low}}[n] = \sum_{k=-\infty}^{\infty} x[k]g[2n-k]$$

$$y_{\mathrm{high}}[n] = \sum_{k=-\infty}^{\infty} x[k]h[2n-k]$$

3. DVBT MODEL:

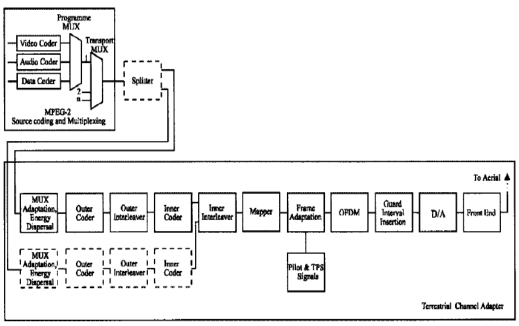

Figure 1.1: DVB-T transmitter [1]

A block diagram of the European DVB-T standard is shown in Figure 1.1. Most of the processes described in this diagram are performed within a digital signal processor (DSP), but the drawbacks occur in the physical channel; i.e., the output signal of this system. Therefore, it is the purpose of this project to provide a description of each of the steps involved in the generation of this signal and the Matlab code for their simulation.

DVB-T as a digital transmission delivers data in a series of discrete blocks at the symbol rate. DVB-T is a COFDM transmission technique which includes the use of a Guard Interval. It allows the receiver to cope with strong multipath situations. Within a geographical area, DVB-T also allows single-frequency network (SFN) operation, where two or more transmitters carrying the **same** data operate on the same frequency. The length of the Guard Interval can be chosen. It is a trade off between data rate and SFN capability. The longer the guard interval the larger is the potential SFN area without creating intersymbol interference (ISI). It is possible to operate SFNs which do not fulfill the guard interval condition if the self-interference is properly planned and monitored.

4. MATHEMATICAL ANALYSIS:

1) CHARACTERISTICS OF OFDM SIGNALS:

Let a block of N symbols $X = \{Xk, k = 0,1 \ldots \ldots N-1\}$ is formed with each symbol modulating one of a set of subcarriers $\{fk, k = 0,1 \ldots \ldots N-1\}$, where N is the number of subcarriers. The N subcarriers are chosen to be orthogonal, that is $fk = k\Delta f$,

Where $\Delta f = \frac{1}{NT}$

And T is the original symbol period. Therefore, the complex envelope of the transmitted

OFDM signals can be written as

$$x(t) = \frac{1}{\sqrt{N}} \sum_{k=0}^{N-1} X_k \, e^{j2\pi fkt,} \quad ,0 < t < NT$$

2) DEFINITION OF PAPR:

A) *Baseband PAPR:*

Continuous-time PAPR:

In general, the PAPR of OFDM signals s(t)is defined as the ratio between the maximum instantaneous power and its average power

$$PAPR[x(t)] = \frac{0 \le t \le NT[x(t)^2]}{P_{av}}$$

B) Passband PAPR:

OFDM system usually does not employ pulse shaping, since the power spectral density of the band-limited OFDM signal is approximately rectangular. Thus, the amplitude of OFDM RF signals can be expressed as

$$x_{PB}(t) = \{\Re\{x(t)e^{j2\pi fct}\}$$

5. PROPOSED MODEL:

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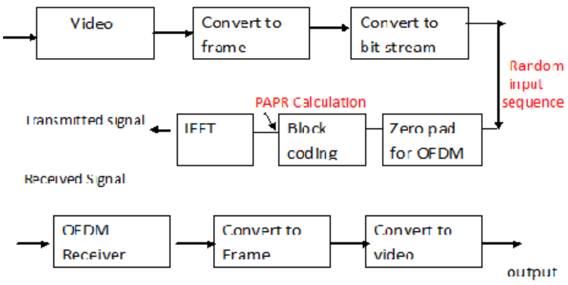


BLOCK DIAGRAM

In this model, we will transmit video which consist of frames. This frame is converted into bit stream which is passed through OFDM transmitter. We will calculate PAPR without applying any method. Then after applying Block Coding Technique we will calculate the PAPR. Further the signal is received by the OFDM receiver.

6. RAYLEIGH FADING CHANNEL

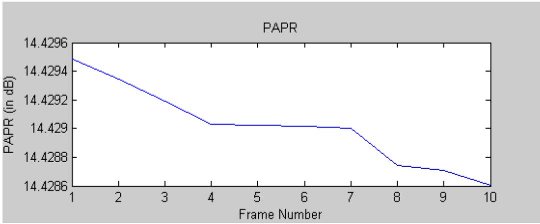
In wireless telecommunications, multipath is the propagation phenomenon that results in radio signals reaching the receiving antenna by two or more paths. Causes of multipath include atmospheric ducting, ionosphere reflection and refraction, and reflection from water bodies and terrestrial objects such as mountains and buildings.

The effects of multipath include constructive and destructive interference, and phase shifting of the signal. This causes Rayleigh fading. The standard statistical model of this gives a distribution known as the Rayleigh distribution. Rayleigh fading is a term used when there is no direct component, and all signals reaching the receiver are reflected. Mathematically, the multipath Rayleigh fading wireless channels modeled by the channel impulse response (CIR)

$$h(t) = \sum_{l=0}^{Lp-1} \alpha_l \, \partial(t - \tau_l)$$

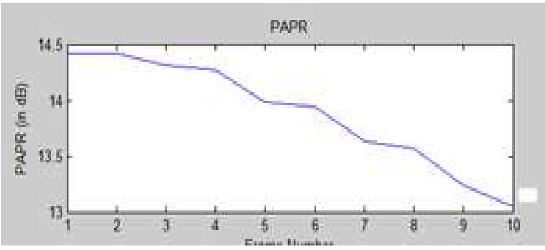
Where, *Lp* is the number of channel paths, *αl* and *τl* are the complex value and delay of path *l*, respectively. The paths are assumed to be statistically independent, with normalized average power. The channel is time variant due to the motion of the mobile terminal, but we will assume that the CIR is constant during one OFDM symbol.

7. a . SIMULATION:



Plot against frame number and PAPR without coding

Using AWGN Channel



Plot against frame number and PAPR with coding using Rayleigh channel.

7. b COMPARATIVE ANALYSIS:

Frame No	PAPR With Rayleigh With coding	PAPR With AWGN Without coding
1	14.41	14.42
2	13.56	14.43
3	13.04	14.43
4	14.27	14.42
5	13.24	14.42
6	13.93	14.42
7	13.98	14.43
8	14.31	14.43
9	13.63	14.43
10	14.42	14.43

This is the Comparative Analysis Between Two Channels ie Rayleigh and AWGN Channel . As we can see that PAPR Reduction is more in Rayleigh Channel

8 .CONCLUSION:

OFDM is a very attractive technique for wireless communications due to its spectrum efficiency and channel robustness .One of the serious drawbacks of in OFDM systems is PAPR .In this paper ,we described several important aspects and Coding Technique .Specifically, a sub-band coding i.e DWT to the image in order to reduce the peak power present. This has been achieved with a minimal increase in complexity and regardless of the number of channels present. Thus by this method 0.5-1 db reduction is there in the system.

In this paper there is Comparative Analysis between two channels, based on that we can see the exact PAPR Reduction in both the Channels. Though Rayleigh channel is having interferences but still there is significant reduction in PAPR.

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