PAPR REDUCTION OF OFDM SIGNAL BY USING HUFFMAN CODING AND SLM.DOC

[1]A.PAVAN, [2]E.V.KRISHNA RAO, [3]B. PRABHAKARA RAO

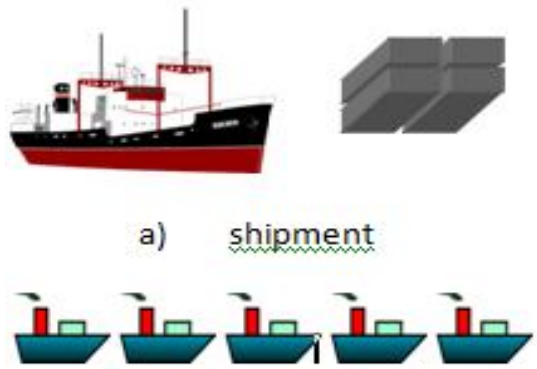
Priyadarshini College, College of Engineering, Nellore, Andhra Pradesh
JNT University Kakinada, Kakinada, Andhra Pradesh
Email: Pavani0504@gmail.com, krishnaraoede@yahoo.co.in, drbpjntu@gmail.com

Abstract: As we know an OFDM is getting popular currently at transmission the data in high rate. In order to achieve better result, some disadvantageous points are being still discussed. One of the major problem related to the OFDM system, the signal peak to average power ratio (PAPR) reduction solutions play an important role to improve performance of OFDM that peak occurs after symbols fed to FFT to produce time domain signal, adding signals up coherently. However, for this problem, 4G projects can find enough approaches to reduce it in this manner. In this paper, our approach to PAPR over a fading channel proposes one of coded mapping method that maintains not only decreasing it, but also contributes to high data rate transmission.

Keywords — PAPR, Huffman coding, Rayleigh fading channel

I. INTRODUCTION

It is obvious, a special case of FDM is called OFDM (orthogonal frequency division modulation) has an adequate amount of QoS in 4G communication systems [1]. To understand them easily, let's peer at the figure 1 below.



b) 5 subcarriers

Figure 1. a) FDM transportation, b) OFDM transportation

As analogy, FDM looks like to a big ship container, in contrast OFDM is in shape of little ship. The advantage in here, the probability of crashes is 1/5 on same shipment amount. This scheme uses subcarriers instead of one and in time domain, even though it is couldn't feel the orthogonality of signals, in frequency domain they have a big differences each other as shown in figure 2. In addition, we could surely witness system's robustness on fixing ISI, ICI problems due to guard period insertion in [2].

On the other hand, after FFT process, summing up the signals brings other looks angrily puzzle called PAPR that have came as a hot topic in wireless communication area, particularly, in OFDM. Next chapter turns into these issue characteristics, while explanation of helpful solutions for it. The 3rd part implements Huffman coding technique over Rayleigh fading channel and performances are superimposed in simulation results of IV section.

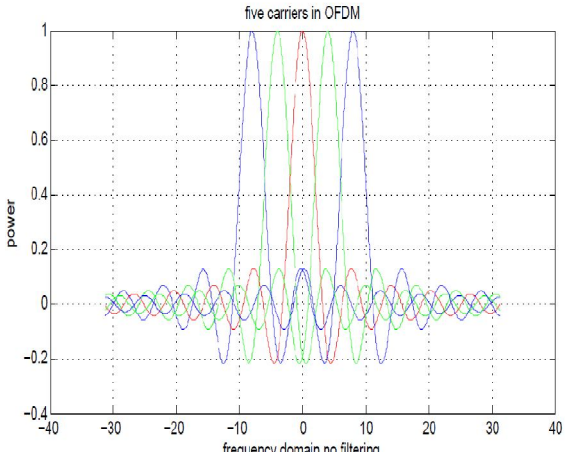


Figure 2. Orthogonality of OFDM signals in frequency domain.

II. PAPR problem in OFDM

To mitigate PAPR, several ideas can be done, such as:
1. Clipping – clip the signals at desired powers level [3];
2. Selective Mapping – coded original data by a coding technique goes through the IFFT, and then selects satisfaction PAPR factor;
3. Partial IFFT – separating signals to clusters do IFFT on each then combine these [4].

Suppose, we have got the result on IFFT in following signal:

$$x(t) = \frac{1}{\sqrt{N}} \sum_{k=0}^{N-1} s_k e^{j2\pi \frac{kt}{JN}} \qquad (1)$$

where s_k denotes the data to be transmitted, N complex symbol block, J sampling factor and t should be in limit of 1<t<JN. Then PAPR can be written as

$$PAPR = \frac{\max |x(t)|^2}{E[|x(t)|^2]}. \qquad (2)$$

Here, E[] identifies expectation.

So that, we should take in a count probability that the signal transcending at a certain threshold which given by

$$\Pr\{PAPR > \lambda\} = 1 - (1 - e^{-\lambda})^N \text{ [5].} \qquad (3)$$

This relationship between threshold value and threshold level on different subcarriers is depicted in Figure 3.

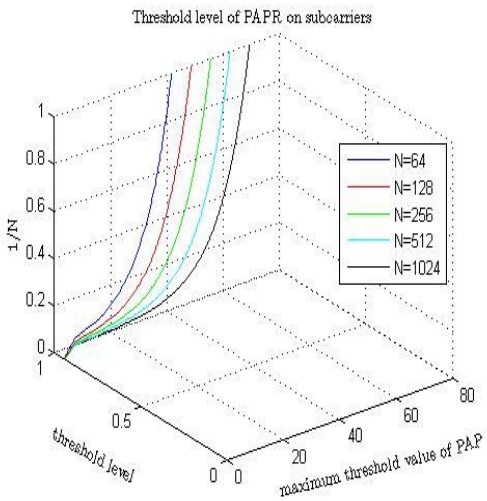


Figure 3. Maximum threshold values on threshold levels by subcarriers.

III. SYSTEM MODEL

The received signal is

$$r(t) = z(t) * x(t) + n(t) \qquad (4)$$

Where $z(t) = \alpha(t)e^{j\theta(t)}$ denotes the complex channel gain [6]. Then, consider an OFDM system with N subcarriers utilize QAM modulation. The transmitted and received symbols are can be

$$x = [x(0), x(1).....x(N-1)]^T \text{ and}$$

$$r = [r(0), r(1)....r(N-1)]^T$$

respectively.

Over multipath environment the received symbol come out by rewrite equation of (4).

$$r(t) = G * x(t) + n(t) \qquad (5)$$

where G is a matrix of g.

$$g(p,q) = \frac{1}{N}\sum_{n=0}^{N-1}\sum_{l=0}^{L-1} h(n,l)e^{-j2\pi n(p-q)/N} e^{-j2\pi ql/N} \qquad (6)$$

Then, we will implement channel estimation and time-frequency selective channel processes as shown in [7]. Figure 4 illustrates system scheme and additionally, guard period is also included by 20% of symbol duration which is higher than delay spread. Huffman coding realization part is described in our previous paper [8].

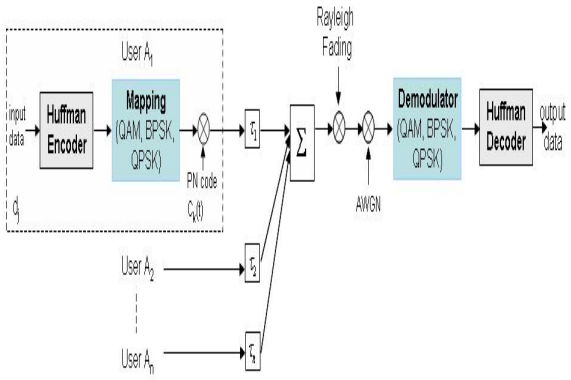


Figure 4. Huffman coded OFDM system over Rayleigh fading channel.

IV. SIMULATION RESULTS

To verify the validity of the expression for the PAPR of a system obtained in the preceding section, we implemented a simulation for the case of coded, without coded and theoretical conditions using a rectangular 16 point QAM signal constellation over Rayleigh fading for chart 5.

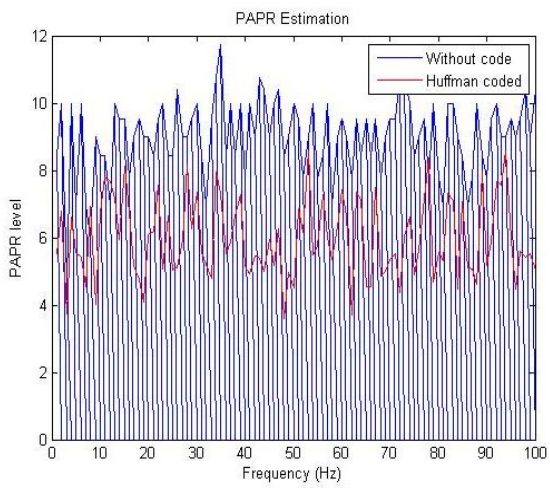


Figure 6. PAPR Estimation

The Figure 6 illustrates PAPR estimation (2) formula simulation of two coded and uncoded signals that by looking at, we can easily can see PAPR decreasing at -3-4db and same result obtained at figure

7 by simulating its probability distribution function.

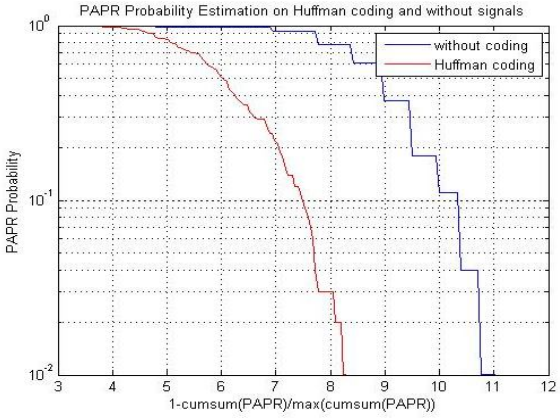


Figure 7. PAPR probability Estimation

CONCLUSION AND FUTURE WORKS

In conclusion, we can notice that by implementation of Huffman coding, we have reached valuable BER and PAPR decreasing results for -3db at least.

For future works, we are going to analyze our ideas not only over Rayleigh, but also include Rician or something like that fading channel to estimate performance of OFDM.

REFERENCES

[1] Hui Liu and Guoqing Li "OFDM- Based Broadband Wireless Networks", p. 5, 2005.
[2] Shinsuke Hara and Ramjee Prasad "Multicarrier Techniques for 4G Mobile Communications", p. 34, 2003.
[3] X. Li and L. J. Cimini Jr., "Effects of clipping and filtering on the performance of OFDM", IEEE Communication Letter, pp. 131-133, May 1998.
[4] Charan Langton "Intuitive Guide to Principles of Communications", p. 20, 2004.
[5] Abdulla A. Abouda "PAPR Reduction of OFDM signal using turbo coding and selective mapping", 2004.
[6] Ola Jetlund, Geir E.Øien and Kjell J.Hole "Adaptive Gallager coded modulation on Rayleigh fading channels", IEEE, 2003.
[7] Jin-Goog Kim, Tae-Joon Kim, Jae-Seang Lee, and Jong-Tae Lim "Channel estimation for OFDM over fast Rayleigh fading channels", 2007.
[8] Sattorov Mashhur, Heau-Jo Kang "Huffman coding approach to performance of 16-QAM/OFDM", 2009.

★★★