ijergs
Open Access
International Journal of Engineering Research and Generic Science (IJERGS)
Available Online at www.ijergs.in
ISSN: 2455 - 1597
Volume -3, Issue - 4, July - August 2017, Page No. 01 - 06

Mapping In Matlab Using OFDM System and Reduction of PAPR

Mr. Shaik. Rasool Saheb
Asst.Professor in H&S Dept.TKREC, Hyderabad
Prof. K. Krishna Murthy
Dept. of Electronics, PG Center, P.B. Siddartha Arts & Science College, Vijayawada, AP, India

Abstract

The OFDM technique divides the total bandwidth into many narrow sub- channels and sends data in parallel. It has various advantages, such as high spectral efficiency, immunity to impulse interference and, frequency selective fading without having powerful channel equalizer. But one of the major drawbacks of the OFDM system is high PAPR. OFDM signal consists of lot of independent modulated subcarriers, which created the problem of PAPR. It is impossible to send this high peak amplitude signals to the transmitter without reducing peaks. So we have to reduce high peak amplitude of the signals before transmitting. Communication is one in all the numerous features of existence. A new DSI-SLM method for PAPR reduction in OFDM system state that the phase sequence and dummy sequences added to the signal improves the PAPR reduction in OFDM signals whereas less hardware resources and less time are required to achieve the desired result.

Keywords: OFDM, ISI, SLM, Reimann Matrix, Distortion, AWGN

1. Introduction

OFDM is a multicarrier modulation technique, which employs several carriers, within the allocated bandwidth, to convey the information from source to destination. OFDM concept is based on spreading the data to be transmitted over a large number of carriers, each being modulated at a low rate. The carriers are made orthogonal to each other by appropriately choosing the frequency spacing between them. A multicarrier system, such as FDM (Frequency Division Multiplexing), divides the total available bandwidth in the spectrum into sub-bands for multiple carriers to transmit in parallel. It combines a large number of low data rate carriers to construct a composite high data rate communication system. Orthogonality gives the carriers a valid reason to be closely spaced with overlapping without ICI.

2. OFDM

The OFDM concept is based on spreading the data to be transmitted over a large number of carriers, each being modulated at a low rate. The carriers are made orthogonal to each other by appropriately choosing the frequency spacing between them. A multicarrier system, such as FDM (Frequency Division Multiplexing), divides the total available bandwidth in the spectrum into sub-bands for multiple carriers to transmit in parallel. It combines a large number of low data rate carriers to construct a composite high data rate communication system. Orthogonality gives the carriers a valid reason to be closely spaced with overlapping without ICI.

3. QAM

Quadrature Amplitude Modulation or QAM is a form of modulation which is widely used for modulating data signals onto a carrier used for radio communications. It is widely used because it offers advantages over other forms of data modulation such as PSK, although many forms of data modulation operate alongside each other. When using QAM, the constellation points are normally arranged in a square grid with equal vertical and horizontal spacing and as a result the most common forms of QAM use a constellation with the number of points equal to a power of 2 i.e. 4, 16, 64.

By using higher order modulation formats, i.e. more points on the constellation, it is possible to transmit more bits per symbol. However the points are closer together and they are therefore more susceptible to noise and data errors. Normally a QAM constellation is square and therefore the most common forms of QAM 16QAM, 64QAM and 256QAM.The advantage of moving to the higher order formats is that there are more points within the constellation and therefore it is possible to transmit more bits per symbol. The downside is that the constellation points are closer together and therefore the link is more susceptible to noise. As a result, higher order versions of QAM are only used when there is a sufficiently high signal to noise ratio.

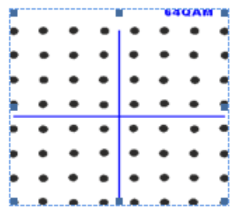


Figure 1 Constellation Diagram of 64 QAM

4. BER Vs SNR

A bit error rate is defined as the rate at which errors occur in a transmission system. This can be directly translated into the number of errors that occur in a string of a stated number of bits. The signal to noise ratio is the ratio between the wanted signal and the unwanted background noise.

$$SNR = \frac{P_{signal}}{P_{noise}}$$

It is more usual to see a signal to noise ratio expressed in a logarithmic basis using decibels:

$$SNR_{dB} = 10 \log_{10}\left(\frac{P_{signal}}{P_{noise}}\right)$$

If all levels are expressed in decibels, then the formula can be simplified to:

$$SNR_{dB} = P_{signal_{dB}} - P_{noise_{dB}}$$

Bit error rate BER is a parameter which gives an excellent indication of the performance of a data link such as radio or fibre optic system. As one of the main parameters of interest in any data link is the number of errors that occur, the bit error rate is a key parameter. Knowledge of the BER also enables other features of the link such as the power and bandwidth, etc to be tailored to enable the required performance to be obtained.

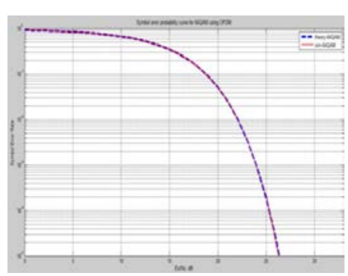


Figure 2: BER vs. SNR Plot

As we can conclude from the above plot that the theoretical points and simulated values overlap each other resulting in correct simulation and description of OFDM system in our MATLAB function. The Value of Bit error rate or in this case symbol error rate is given on the y-axis and the values for signal to noise ratio are plotted on the x-axis. The scale is plotted on a logarithmic one and the axis coordinates are defined accordingly on the upper right corner.

5. PAPR

The peak-to-average power ratio (PAPR) is the peak amplitude squared (giving the peak power) divided by the RMS value squared (giving the average power). It is the square of the crest factor.

$$PAPR_{dB} = 10\log_{10}\frac{|x|_{\text{peak}}{}^2}{x_{\text{rms}}{}^2} = C_{dB}^2.$$

When expressed in decibels, crest factor and PAPR are equivalent, due to the way decibels are calculated for power ratios vs amplitude ratios. The PAPR is most used in signal processing applications. As it is a power ratio, it is normally expressed in decibels (dB).

6. Problems Related To PAPR

1. Power Peaks: In order to accommodate this peak in power, the radio's RF power amplifier (PA) must provide gain without compression for every peak power level. In other words, the PA will provide less RF power between peaks, by an amount given by the PAPR.

Not only does this imply that the power amplifier must be oversized in terms of its average power requirement, it also means that the efficiency of the PA will suffer dramatically, since its DC power consumption is determined by the peak power level. Since the DC power consumption of the PA represents a significant portion of the total DC power for a radio, traditionally designed OFDM modems are not power efficient.

2. Non linearity: For higher-level modulations such as a 64 quadrature amplitude modulation (QAM) scheme, these constellation clouds can contribute to an increase in bit errors for each carrier. Even a modest increase in bit error rate (BER) for each carrier can result in a dramatic increase in the cumulative error rate over a packet. Thus, in an OFDM modem design, linearity must be carefully controlled.

3. Image Rejection: The latest trend in receiver design is to reduce or eliminate the intermediate frequency (IF) stage in order to eliminate costly additional filtering circuitry. While this streamlines the receiver, it makes it more difficult to control image rejection, because designers cannot make use of external RF and IF filtering. At best, insufficient image rejection in an OFDM modem reduces the carrier-to-noise ratio available for the demodulator. At worst, it allows another signal to interfere with the OFDM signal, resulting in a catastrophic increase in error rate.

4. Phase Distortion: OFDM provides a selection of modulation constellations for each carrier. For example, the 802.11a standard provides for individual carrier modulation up to 64 quadrature amplitude modulation (QAM). Although signal impairments due to multi-path are eliminated through the use of a cyclic prefix guard interval (during which no demodulation is performed in the receiver), the closeness of the constellation points can result in significant errors due to dispersion. This dispersion can be caused by motion of the radio units or from motion of any other object in the channel. It can also be caused by phase variation with frequency in the radio antennas, filters, and other components.

7. Removal of PAPR

A. SLM

The Riemann matrix [17] is obtained by removing the first row and first column of the matrix R, ***Where*** Behaviour of OFDM System and Reduction of Its PAPR by Using Selective Mapping in Matlab.

$$R(i,j) = \begin{cases} i-1 & if\ i\ divides\ j \\ -1 & otherwise \end{cases}$$

Using This Equation , Riemann Matrix (A) of order 4 can be written as:

$$A = \begin{bmatrix} 1 & -1 & -1 & -1 \\ -1 & 2 & -1 & -1 \\ 3 & -1 & 3 & -1 \\ -1 & -1 & -1 & 4 \end{bmatrix}$$

The SLM technique was first described by Bauml In the SLM, the input data sequences are multiplied by each of the phase sequences to generate alternative input symbol sequences. Each of these alternative input data sequences is made the IFFT operation, and then the one with the lowest PAPR is selected for transmission. Figure shows the block of the SLM technique. Ak is the OFDM data block, Bu is the phase vectors and Au is the modified data vectors in the frequency domain.

Figure 3: Selective Mapping

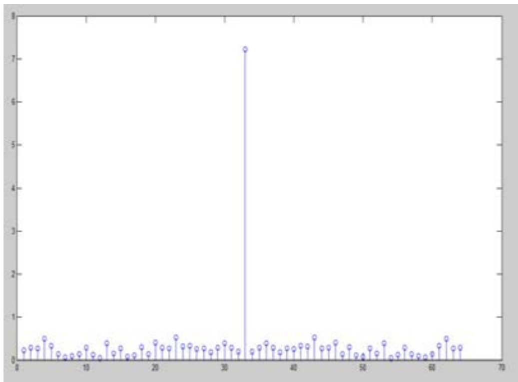
So the time domain signal

$$a_u(t) = \frac{1}{\sqrt{N}} \sum_{k=0}^{N-1} A_k B_{u,k} e^{j2\Pi k\Delta ft} \qquad 0 \le t \le NT$$

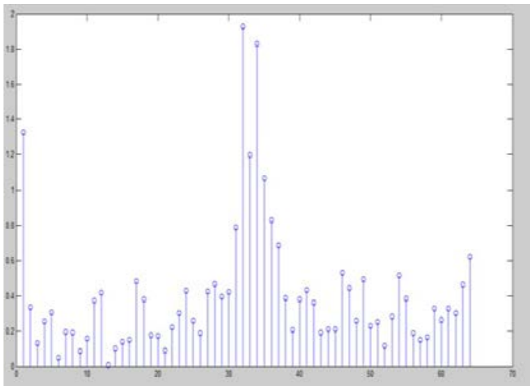
Where u=1, 2… U and N is length of A, also the number of sub-carriers. Among the modified data blocks, the one with the lowest PAPR is selected for transmission. The amount of PAPR reduction for SLM depends on the number of phase sequences U and the design of the phase sequences.

8. Results

PAPR before Implementing SLM technique:



PAPR after Implementing SLM technique:



9. References

[1]. Ben Slimane S (2007), Reducing the Peak-to-Average Power Ratio of OFDM Signals Through Pre-coding, *IEEE Trans. Vehicular Technology*, 56(2), pp. 686- 695.

[2]. Hee Han S and Hong Lee J (2004), PAPR Reduction of OFDM Signals Using a Reduced Complexity PTS Technique, *Signal Processing Letters*, *IEEE*, 11(11), pp. 887-890.

[3]. Homayoun Nikookar and Sverre Lidsheim K (2002), Random Phase Updating Algorithm for OFDM Transmission with Low PAPR, *IEEE Trans. Broadcasting*, 48(2), pp. 123–128.

[4]. Luqing Wang and Chintha Tellambura (2005), A Simplified Clipping and Filtering Technique for PAR Reduction in OFDM Systems, *Signal Processing Letters, IEEE*, 12(6), pp. 453–456.

[5]. Ramjee Prasad (2004), OFDM for Wireless Communications, pp. 11–13, Universal Personal Communications Series.

[6]. Tellado-Mourelo J (1999), Peak to Average Power Ratio Reduction for Multicarrier Modulation, Ph.D. Thesis, University of Stanford.

[7]. Van Nee R and de Wild A (1998), Reducing the Peak-to-Average Power Ratio of OFDM", *VTC98.48th IEEE*, 3, May 18–21, pp. 2072–2076.

[8]. Varun Jeoti and Imran Baig (2009), A Novel Zadoff-Chu Pre-coder Based SLM Technique for PAPR Reduction in OFDM Systems, Invited Paper, Proceedings of 2009 IEEE International Conference on Antennas, Propagation and Systems (IAS), December 3–5, Johor, Malaysia.

[9]. Meixia Hu, Yongzhao Li, Yi Liu, Hailin Zhang, Parameter-adjustable piecewise exponential companding scheme for peak-to-average power ratio reduction in orthogonal frequency division multiplexing systems, Published in *IET Communications*, Received on 21st March 2014, DOI: 10.1049/iet- com.2013.0226.

[10]. N. R. Raajan, S. Prabha, D. Meenakshi, Improved Performance In OFDM Systems by PAPR Reduction Techniques, 2013 *International Conference on Computer Communication and Informatics* (ICCCI -2013), Jan. 04–06,2013, Coimbatore, INDIA