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Modified Method of PAPR Reduction using Clipping and Filtering for Image Transmission with OFDM

Ghassan Muslim Hassan[1*], Muaadh Mukred[2], Abdu Hasan Gumaei[3]

[1]Department of Computer, College of Science, Mustansiriyah University, 10052 Baghdad, IRAQ,
[2]Faculty of Information Science and Technology, Universiti Kebangsaan Malaysia, 43600 Bangi, MALAYSIA.
[3]Department of Computer Science, College of Computer Engineering and Sciences, Prince Sattam Bin Abdulaziz University, Al-Kharj 11942, SAUDI ARABIA

*Correspondent contact: gmhalsaddi@uomustansiriyah.edu.iq

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ABSTRACT

Due to the capability of OFDM (Orthogonal Frequency Division Multiplexing) to handle difficult channels, the most agreeable modulation for the multi-carrier scheme in present wireless communications is to improve an all-purpose modulation scheme, especially with high data rates. The image in this research article was transmitted and received on a noisy channel using an OFDM simulation technique. Since the average peak power ratio (PAPR) is one of the main disadvantages of OFDM, a new method has been proposed to reduce the PAPR using the clipping and filtering (CF) method. When the OFDM signal has a high PAPR, it means that many subcarrier components will be added through the operation of IFFT. Also, choosing the type of modulation to examine and getting a perfect type of OFDM system that is used for transmitting the image. Furthermore, signal-to-noise ratio (SNR) was considered to find the PAPR effect on the OFDM signal. The new method was tested to get a reduction of PAPR concerning CF and without CF. This method depends on clipping the signal before transmitting it, by using a method to overcome a nonlinear distortion, and therefore, decrease the bit error rate (BER). Then a filter with multi-stages was used to minimize the noise. This whole process was repeated several times to overcome the difficulties of transmitting/receiving the signal including PAPR. BER and SNR show wonderful outcomes when BPSK is chosen. Control over transmission and reception is also considered to be the type of modulation. All simulation results were defined using an Additive White Gaussian Noise (AWGN) channel.

KEYWORDS: OFDM, PAPR, BER, clipping & filtering, SNR.

الخلاصة

نظرًا لقدرة تقنية الـ OFDM على معالجة القنوات الصعبة، فإنها تعتبر الأكثر قبولًا في الاتصالات اللاسلكية الحالية لتطوير الطريقة العامة للـ modulation، خاصة في معدلات ارسال البيانات بسرعة عالية. في ورقة البحث هذه، تم نقل الصورة واستقبالها في القناة الصاخبة باستخدام محاكاة لتقنية OFDM، مع مراعاة استهلاك الطاقة. طالما أن متوسط الذروة إلى نسبة القدرة (PAPR) هو العيب الرئيسي لـ OFDM، تم اقتراح طريقة جديدة لتقليل PAPR، باستخدام طريقة القص والتصفية. (CF) عندما تحتوي إشارة OFDM على نسبة عالية من PAPR، فهذا يعني أن العديد من مكونات الموجة الحاملة الفرعية ستضيف من خلال تنفيذ عملية الـ IFFT. كما يتم اختيار نوع modulation، مثل PSK وكذلك QAM، للفحص والحصول على النوع المثالي من نظام OFDM المستخدم لإرسال الصورة. كما تم استخدام نسبة الإشارة إلى الضوضاء (SNR) التي تعد أحد الميزات الرئيسية لأنظمة OFDM لإيجاد تأثير PAPR على إشارة الـOFDM. تم اختبار الطريقة الجديدة للحصول على تقليل PAPR فيما يتعلق بـ CF وبدون CF. تعتمد هذه الطريقة على قص الإشارة قبل إرسالها، وذلك باستخدام طريقة للتغلب على التشوه غير الخطي، وبالتالي تقليل معدل الخطأ في البتات BER بعدها يتم استخدام مرشح متعدد المراحل بمواصفات مثالية لتقليل الضوضاء. تم تكرار هذه العملية برمتها عدة مرات للتغلب على صعوبات إرسال / استقبال الإشارة. تظهر BER و SNR نتائج رائعة عند اختيار BPSK. كما ويعتبر التحكم في الإرسال والاستقبال أيضًا من أنواع التشكيل. جاءت نتائج تقييم الأداء التي تم الحصول عليها من خلال المحاكاة باستخدام MATLAB، في قناة AWGN.

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INTRODUCTION

Orthogonal Frequency Division Multiplexing (OFDM) is responsible for high-speed data transmission and is characterized by resistance to multipath fading, the data rate in high mode, and great spectral efficiency [1]. OFDM was made a correct option for wireless systems when using Digital Signal Processing (DSP), [2]. Lately, the OFDM was chosen in the applications of high data rates. At this time, OFDM is used in local area networks, especially in wireless (IEEE802.11g, IEEE802.11a). Also, it is used in fourth-generation cellular systems [3].

OFDM technology consists of dividing the radio signal into several smaller sub-signals, these sub-signals are then transmitted simultaneously to the receiver on different frequencies, in other words, the main band (BW) is split into several sub-bands. The use of OFDM reduced the crosstalk in the signal [4]. Some of the advantages of OFDM are the ability to manage severe channel requirements without the need for a complicated equalization filter, such as Frequency-selective fading due to multipath and narrow-band interference [5]. With OFDM, several overlapping, orthogonal, and narrow-band subcarriers are sent in parallel, which the digital communications it uses. By using a fading channel with no degrading, characteristic of the perceptual, image transmission is a difficult task that reduces power consumption in various fields such as broadband networks, mobile communication, video transmission, and image sharing. Also, in many applications like video streaming, you cannot resend the missing packets every time [6].

This paper was arranged as follows: Section 2 shows some literature reviews used for OFDM works including PAPR. PAPR, which is one of the major disadvantages of OFDM, is explained in section 3 listing the methods of reducing PAPR. In contrast, section 4 describes a methodology of the work with sending and receiving the data (image) which was done by using the proposed algorithm. The algorithm of this work appeared in section 5. In section 6, the performance of PAPR has been explained. Simulation analysis and results are carried out in section 7. After all, the conclusion was done in section 8.

RELATED WORK

Devi and Naresh [6] presented a useful method of transmitting color images that is proposed with power savings around the OFDM system. The quality of the reception of the received image is similarly quite good thanks to the different peak SNR ratios that retain energy equal to 60%. But the issue of timing hasn't even addressed the issue of the PAPR.

Hassan *et al.* [1] stated when an image has been transmitted from the transmitter to the receiver, the perfect type of modulation is BPSK. The drawback of their work is maintaining the ratio value of the signal-to-noise, which is an important issue of communication.

Patne and Pusdekar [7] show how the Discrete Sine Transform (DST) added for the technique enhances the character of the images compared to the reconstructed ones and shrinks the PAPR of the signal. They concentrate on the fact that the PAPR current in the OFDM signal is greatly reduced (creating non-linearity on the receiving end). Also, a signal is affected by the Doppler frequency.

While Sharma and Gupta [8] presents an energy-saving approach for the transmission of compressed image frames based on a discrete wavelet transform on OFDM channels. Based on the one-bit channel status information in the transmitter, the specification is assigned to the current ideal channels in descending order of priority.

Shareef and Ahsan [9] represent a compressed image using a Discrete Wavelet Transform (DWT) with compressed data spread across four subbands. These sub-bands are then grouped and serially mapped in an OFDM system. In the receiver, when a channel has been received, the faulty channel is discarded by the receiver side.

Hassan *et al.* [10] presents an illustration of the structure belonging to the OFDM was reviewed with a transmitter and the receiver of a system. The BER is a highly significant

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implementation of the OFDM system. The type of modulation and demodulation as well as the transmission and reception control are taken into account. A major disadvantage of the system is the peak-to-power ratio. Several techniques are used to reduce PAPR, however, the simplest technique is cutting and sieving. The main disadvantage of increasing the number of subcarriers is a reduction in spectrum efficiency utilization.

Elsharief *et al.* [11] explain the implementation of the Simulink to all function blocks of a normal DVB-T transceiver and present the type of simulation for a system of DVB-T belonging to the European Telecommunications Standards Institute (ETSI EN 300 744 V1.6.1). The prototype contains all the basic building blocks of channel coding and coefficient modulation: 8K in OFDM mode, modulation (64-QAM, 16-QAM), and code rate (1/2, 2/3, and 3/4).

The principle of orthogonality allows the perfect use of bandwidth, but this does not avoid the OFDM system suffering from PAPR due to the low efficiency of the power in the amplification of the nonlinear power. One of the methods to minimize this problem is using a technique of clipping with peak windowing which is proposed by [12] to enhance the OFDM performance. From the simulation results, the authors reach the fact that the level of clipping threshold equal to 0.7 leads to minimizing PAPR of 8dB.

Timande and Nigam [13] proposed a modified Iterative Clipping and Filtering technique to decrease the PAPR. This technique is to use a free degree required by the guard area. When using a suitable filter, the signal in the guard area is allowed to be diverse in a small magnitude. The proposed technique shows that it can decrease the PAPR effectively with weak Bit error rate performance loss.

Dhok and Dhanvijay [14] proposed a delay estimator for channel extension was proposed and the DVB system was analyzed. The authors take into account the Doppler frequency and the synchronization problem but do not mention the PAPR effect.

In Dachuri, N. Uppala [15], an image frame compressed using DWT is used, where the compressed data is coordinated into data vectors with an equal number of coefficients, bit streams were obtained using the quantization technique and binary coding. Then intelligently packed and assigned to the OFDM system.

While in Soni and Tiwari [16], the performance of the peak SNR (PSNR) belongs to the system of conventional FFT-OFDM with a system of discrete cosine transform DCT-OFD which was compared with a system of DWT -OFDM in the environment of a Gaussian Noise with low-density parity-check (LDPC).

Li *et al.* [17] discussed estimation algorithms of the carrier frequency offset (CFO). Simulation data and theoretical analysis confirm that the quantization error was caused by small-precision quantization, and therefore extensively reducing the execution of the receiver system.

In Sharma *et al.* [18], They found that OFDM has many advantages compared to single carrier modulation, such as Immunity to impulse interference, high spectral density, resilience to radio frequency (RF) interference, resilience to channel fading, multipath resilience, and much lower complexity of the computational process.

Arjun and Surekhe [19] studies the performance of PAPR related to OFDM and wavelet OFDM (WOFDM) using modified selective mapping (SLM). The authors address two problems. One is to ensure minimum power transmitted, which is required to increase the channel capacity. While the second is PAPR reduction by changing the subcarrier’s phase of WOFDM.

A self-adjustment gain scheme for decreasing PAPR values without increasing error probability is presented in [20]. This technique changes each cut sign to highlight another position, as per the proportions between the remaining and framework powers for diminishing the framework blunders, which have the impact of controlling the situation with information after input of the

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section signals. For the purpose of updating each signal constellation, the adaptive self-adjustment gain takes a portion of the difference between the clipped state and the original state.

PAPR OF OFDM

The Average Peak Power Ratio (PAPR) is one of the main disadvantages of OFDM. The problem with subcarriers lies in the digital-to-analog converter (DAC), which operates on a wider range of elements. In addition, the transmitter power amplification operates over a large linear range to prevent spectrum scattering and hence out-of-bandwidth.

In multicarrier systems, PAPR occurs when the subcarriers are out of phase [21]. The ratio between the greatest value of the sample power enclosed in the transmitted OFDM signal and the average power of the OFDM signal denoted as a PAPR is according to Equation 1.

$$PAPR = \frac{Ppeak}{Paverage} = \frac{max[|X(n)|^2]}{E[|X(n)|^2]} \quad (1)$$

where P_{peak} is the output of the peak power, $P_{average}$ is the average power, *E[]* is the estimated value, and *X(n)* is the OFDM transmitted signal.

To bypass the effect of PAPR, the power of the transmitted signal must be reduced, therefore, the SNR will minimize leading to reduced BER.

1. **Disadvantages of PAPR**

   The disadvantages of PAPR can summarize as:

- The signal peak collapse in a nonlinear zone of the power amplifier will be the reason for distortion of the signal.
- On the transmitter side, the efficiency of the power amplifier will degrade.
- The Signal to Quantization Noise Ratio (SQNR) will drop in DAC and ADC.
- The principle of orthogonality will be destroyed for various subcarriers which generate the power leak between the subcarriers.

2. **PAPR Reduction Techniques**

   Different proposed techniques used for PAPR reduction are illustrated in [19-23], which are divided into three sets as shown in Figure 1.

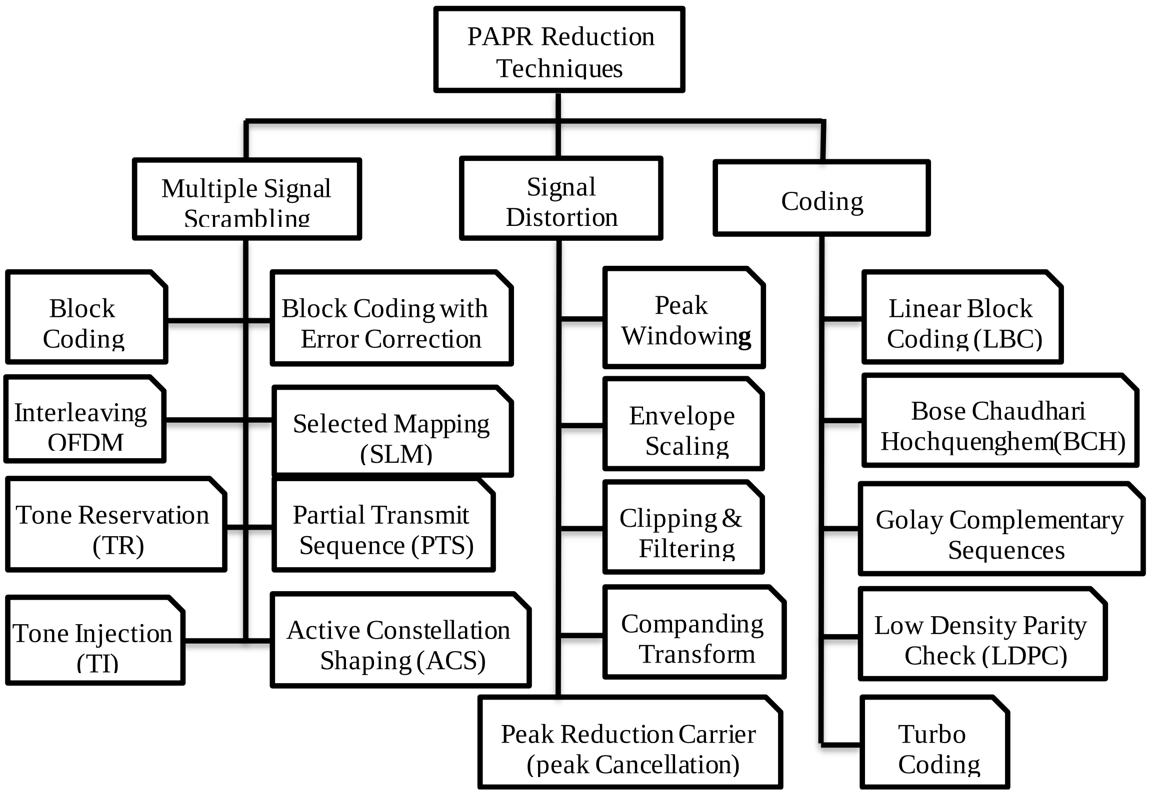

Figure 1. Techniques for PAPR reduction.

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One of the simplest and most pragmatic approaches is clipping and filtering, which can limit the signal to the transmitter to eliminate the occurrence of high peaks above a certain level. However, due to the non-linear distortions introduced by this process, the orthogonality is somewhat destroyed, resulting in in-band noise and out-of-band noise [24]. In-band noise cannot be filtered, it reduces BER. Out-of-band noise reduces BW efficiency, but frequency domain filtering [24] can be used to minimize out-of-band power. While filtering is great for removing noise, it can regrow peaks. The whole process is repeated several times to overcome this drawback until the desired situation is achieved [22].

MATERIALS AND METHODS

If the time of the reflection is a smaller amount than the guard cycle which is used in the OFDM signal, then the OFDM has full immunity to the multipath delay spread. The block diagram of the transceiver of the OFDM is shown in Figure 2. On the transmitter side, the transmitted OFDM signal appeared as in equation 4. On the transmitter side, the binary data is converted to be ready for transmission. Once converting the incoming data binary from the mode of serial to parallel (S/P) and then modulating with QAM or PSK, the data was transformed from frequency to time domain by using IFFT. Then zero padding is added to help synchronization. The data was then changed from parallel to serial mode (P/S), keeping track of digital to analog conversion (DAC). The signal output is represented by the Equation 2.

$$x(n) = \frac{1}{\sqrt{N}} \sum_{m=0}^{N-1} X(m).e^{\frac{j2\pi nm}{N}} \qquad (2)$$

where *x(n)* is the signal of the OFDM, *X(m)* in the frequency domain for the m^{th} subcarrier represents the modulated symbol, $N-1 \geq m \geq 0$, *n* in the time domain represents a sample index, while *N* represents the subcarrier's number.

At the receiver side, the signal was combined with the AWGN due to the channel, and the retrieved signal was represented as in Equation 3. The receiver operates the reverse operation of the transmitter. Zeros added at the transmitter which are used to aid in synchronization must be removed at the receiver. Analog to digital conversion (ADC), and serial mode to parallel mode (S/P), are also must be done. FFT must be done for the operation to return to the frequency domain.

$$Y(m) = \sum_{n=0}^{N-1} y(n).e^{\frac{j2\pi n\varepsilon}{N}} + w(n) \qquad (3)$$

where the output of the FFT is represented by *Y(m)*, AWGN represents by *w(n)*, and the received signal *y(n)* in accordance with crossing over the AWGN channel which is influenced by the frequency offset, while normalized frequency offset *(ε)* is the which is given by $\Delta fNTs$, where Δf is the local oscillator frequency variance between receiver and transmitter, and *Ts* belongs to a symbol period.

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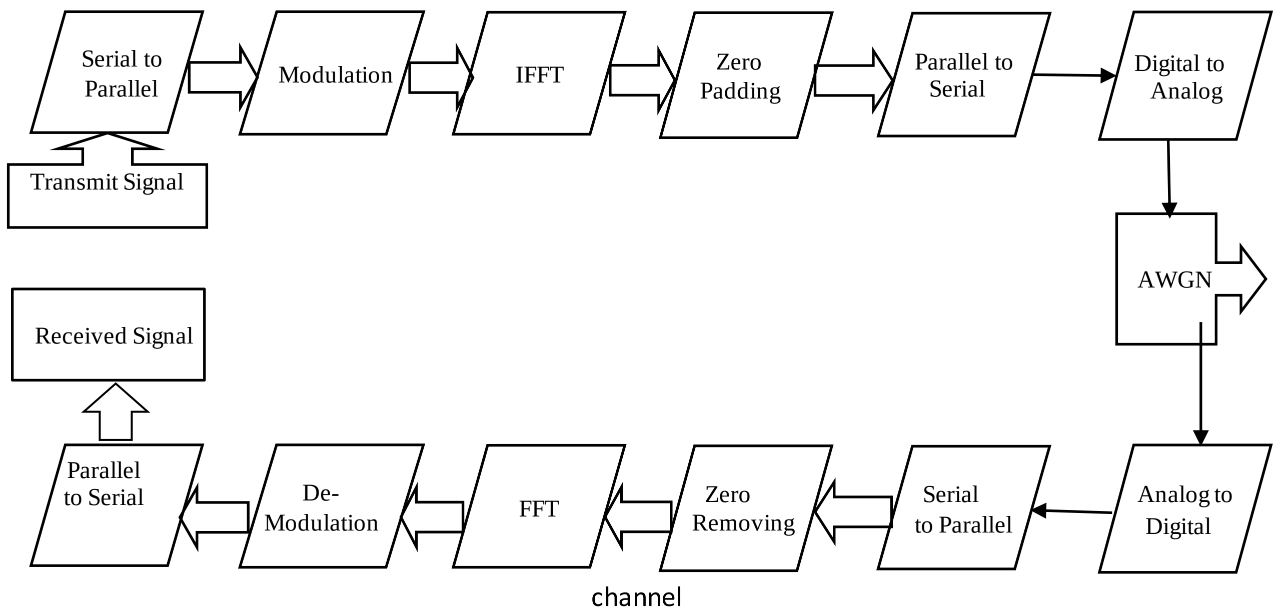

Figure 2. Block diagram of OFDM transceiver.

The Proposed Algorithm

The proposed method algorithm is as follows:

On Transmitter Side

After reading the image's data, this data must be converted from serial to parallel. Using (BPSK, QPSK, 8PSK, 16QAM, and 64QAM) have been chosen as modulation and demodulation in the transmitter and receiver sides respectively. By using the IFFT method, the data will be converted from frequency to time domain. Zero-padding was done by adding zeros to guard the signal. The signal-to-noise ratio (SNR) was applied for multi values (0, 2, 4, …., 30). Before the transmit operation is done, the data will be converted from parallel to serial, by using a digital-to-analog (D/A) converter. At this point, the OFDM signal is ready to transmit. AWGN and noise were added to the OFDM signal via the transmission channel. The power of data was calculated to be used in the calculations.

On Receiver Side:

The inverse operations have been done, which converting the receiving data from analog-to-digital (A/D), serial to parallel, removing zeros (guard band), Convert time to frequency domain data by means of FFT, channel estimation, application of demodulation, and parallel-to-serial conversion to get a signal like Equation 5. At the end of the algorithm, BER was calculated to consider the performance of the proposed algorithm, then to recover the sending image.

In the meantime, the modified proposed method for minimizing PAPR was applied to get the results. The proposed new method to reduce the effect of the PAPR is a way to improve it. It is enhanced by the clipping and filtering method (CF). The clipping in the transmitted signal, and then choosing a filter to refine acceptable specifications to overcome the noise generated.

RESULTS AND DISCUSSION

Performance of PAPR

1. Bit Error Rate (BER)

The BER which is used in communication is the major performance at the end of the receiver. BER can be influenced by crosstalk, distortion, multipath fading, and noise. The BER can be increased by selecting a high signal strength, selecting a robust and slower modulation technique or a linear coding technique, and using coding of channel techniques like pathless error correction codes and redundant feedback loops [3]. In many applications, BER is also suitable because it indicates how long to wait before an error appears [25]. In general, BER can be expressed mathematically by Equation 4:

$$BER = \frac{number\ of\ errors}{total\ number\ of\ bits\ sent} \qquad (4)$$

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There are some factors affecting the estimation of the BER, like the type of data transmitted over a BER measurement that can affect the result. Also, the string of similar bits (for example, all of them are 1) will usually produce different error rate numbers, because the string of the same bits could disturb the truth of the BER quantity. There are some degrading causes of BER, such as,

- Interference of neighboring channels.
- Fake alerts from extra channels.
- Searching for transmission interference.
- Access to Channel (Noise and Pulse)
- Incorrectly aligned and/or defective amplifiers.

2. PAPR with Clipping Factor

All The values of PAPR vary with the use type of modulation concerning the clipping factor as mentioned in Tables (1, 2, 3, 4, and 5), also in Figure 3.

Table 1. PAPR values using different modulation types with clip and filter when factor=0.1.

Factor=0.1								
Mod. type	**Original**	**With clipping**	**Clipping & filter1**	**Clipping & filter2**	**Clipping & filter3**	**Clipping & filter4**	**Clipping & filter5**	**Clipping & filter6**
BPSK	91.9136	85.5758	62.1820	46.3867	46.5277	46.1959	45.8704	45.6582
QPSK	84.0194	90.5503	69.3518	55.0209	55.6749	54.9328	54.6875	54.4755
8PSK	76.5949	85.3005	57.7136	51.7857	51.8338	52.2910	52.6805	53.0414
16QAM	77.3874	95.0649	62.1802	54.1948	53.7214	53.6427	53.4778	53.3943
64QAM	73.9882	88.0649	61.9625	53.9406	53.8973	54.6589	55.2675	55.9165

Table 2. PAPR values using different modulation types with clip and filter when factor=0.2.

Factor=0.2								
Mod. type	**Original**	**With clipping**	**Clipping & filter1**	**Clipping & filter2**	**Clipping & filter3**	**Clipping & filter4**	**Clipping & filter5**	**Clipping & filter6**
BPSK	91.9136	85.2037	62.2273	42.1140	40.8774	40.6426	40.4890	40.3631
QPSK	84.0194	90.3003	69.3564	51.6050	51.7839	50.4854	49.8163	49.2396
8PSK	76.5949	85.0910	58.1262	50.4070	50.7800	51.2511	51.6680	52.0252
16QAM	77.3874	94.7197	61.4003	53.5255	52.0450	51.6418	51.0768	50.6309
64QAM	73.9882	87.7619	61.3439	50.6807	49.9573	50.4839	50.8779	51.3885

Table 3. PAPR values using different modulation types with clip and filter when factor=0.3.

Factor=0.3								
Mod. type	**Original**	**With clipping**	**Clipping & filter1**	**Clipping & filter2**	**Clipping & filter3**	**Clipping & filter4**	**Clipping & filter5**	**Clipping & filter6**
BPSK	91.9136	84.9709	62.1556	40.5677	39.4511	39.2715	39.5998	39.9720
QPSK	84.0194	90.1652	69.1420	49.6343	49.4377	47.8133	46.8576	46.0487
8PSK	76.5949	84.9599	60.0464	49.5547	50.1058	50.5416	50.9511	51.2855
16QAM	77.3874	94.4964	60.3415	52.2498	50.0709	49.4008	48.5420	47.8383
64QAM	73.9882	87.5268	60.4579	47.1689	46.5850	47.9172	48.8135	49.4581

Table 4. PAPR values using different modulation types with clip and filter when factor=0.4

Factor=0.4								
Mod. type	**Original**	**With clipping**	**Clipping & filter1**	**Clipping & filter2**	**Clipping & filter3**	**Clipping & filter4**	**Clipping & filter5**	**Clipping & filter6**
BPSK	91.9136	84.8462	62.0443	40.4632	39.3536	39.1806	39.5146	39.8916
QPSK	84.0194	90.0635	69.1419	48.6304	48.0945	46.2970	45.1248	45.2296
8PSK	76.5949	84.8617	61.1790	49.3647	49.9599	50.3602	50.7497	51.0575
16QAM	77.3874	94.3368	60.3298	50.6976	48.4341	47.6694	46.7066	45.9039
64QAM	73.9882	87.3760	59.6008	45.5613	47.2264	48.6172	49.5275	50.1863

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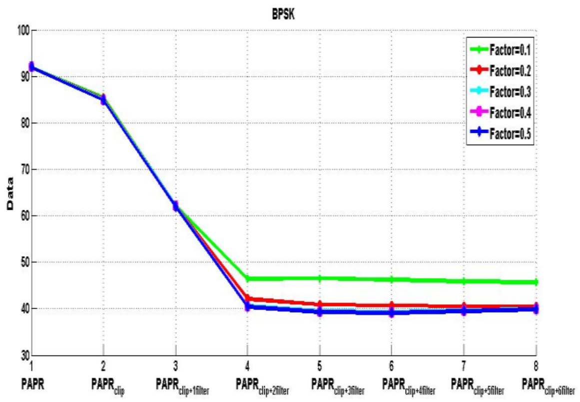
Table 5. PAPR values using different modulation types with clip and filter when factor=0.5.

Factor=0.5								
Mod. type	**Original**	**With clipping**	**Clipping & filter1**	**Clipping & filter2**	**Clipping & filter3**	**Clipping & filter4**	**Clipping & filter5**	**Clipping & filter6**
BPSK	91.9136	84.7917	61.9824	40.4009	39.2933	39.1228	39.4595	39.8389
QPSK	84.0194	90.0197	69.1129	48.4346	47.7988	45.9646	44.7440	45.1991
8PSK	76.5949	84.8327	61.6668	49.3493	49.9484	50.3517	50.7435	51.0532
16QAM	77.3874	94.1608	60.4419	48.9210	46.7118	45.8903	44.8613	43.9899
64QAM	73.9882	87.3138	59.4943	45.5859	47.2544	48.6487	49.5625	50.2245



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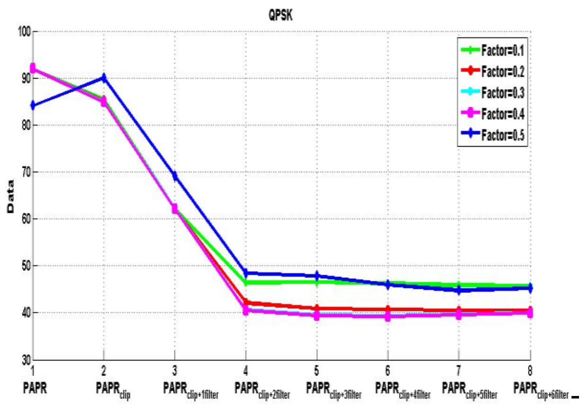

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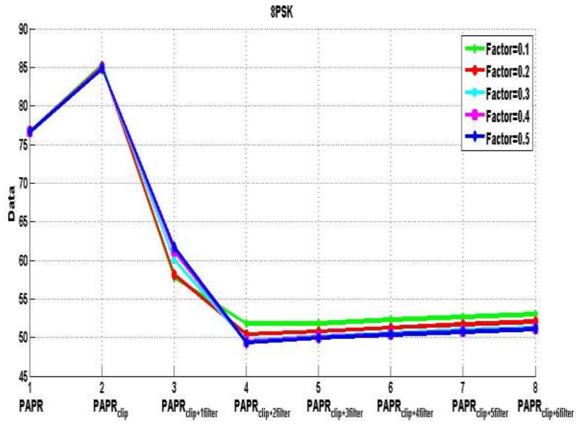

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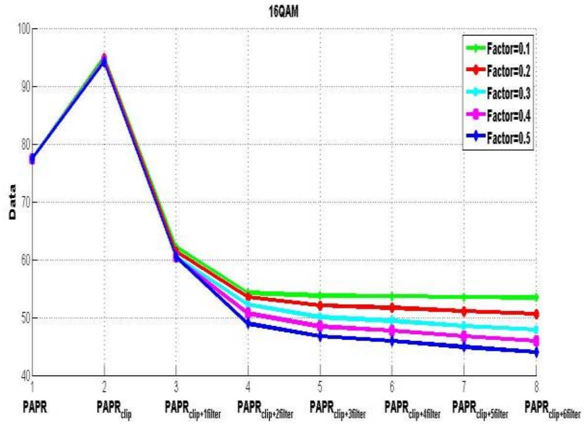

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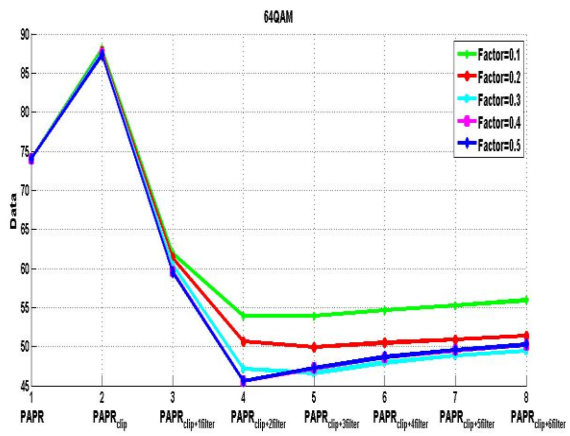

(e)

Figure 3. Data with PAPR and different values of clipping factor and multi-filter stages on different types a. BPSK modulation b. QPSK modulation c. 8PSK modulation d. 16QAM modulation e. 64QAM modulation.

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RESULTS AND DISCUSSION

Initially, the algorithm has been implemented with image reading and transmitting it with several types of modulation (BPSK, QPSK, 8PSK, 16QAM, and 64QAM), with SNR beginning from 0 dB till 30 dB step 2.

Design of Filter

The filter in OFDM which is used after clipping to reduce PAPR must be designed carefully because it has an important part in the algorithm to the frequency of the signal with better flexibility between the frequency and time localization, which results in scattering in the time domain [26].

One of the appropriate spectrum-shaping filters used in the OFDM system is a sinc filter, which is a low pass filter (LPF), because of its ability to prevent the emission of the signal. Also, a window mask in the time domain was used to give suitable time localization in addition to providing soft transitions in the time domain for the filter's ends of impulse reaction [27]. The filter was obtained by multiplying the rooted raised cosine and sinc functions. The filter bandwidth can be expressed according to the whole width of the frequency of the subcarriers. The time of the main energy in the time domain is smaller when compared with the length of the OFDM symbol because of the large bandwidth of the filter for both Rx and Tx compared to the spacing of the subcarrier. The filter response of the time-domain sinc impulse can be represented.

$$F(n) = GLPF(n) * I(n) \qquad (5)$$

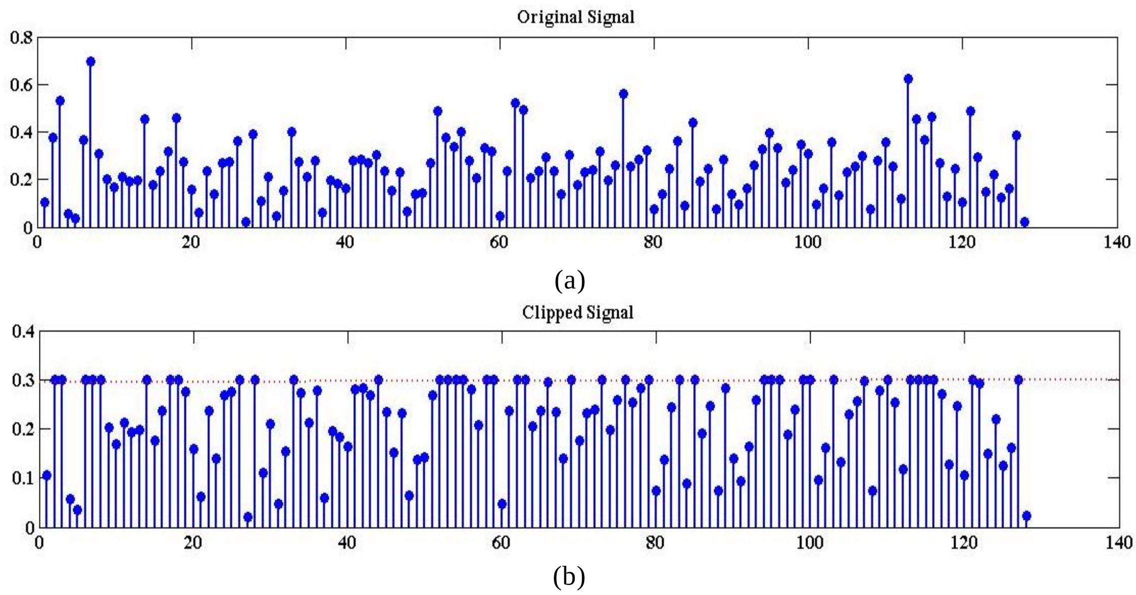
where:

$$GLPF(n) = sin(fc * n)/fc * n \qquad (6)$$

where *GLPF* is the impulse response of the low pass filter, *fc* is the cutoff frequency of the low pass filter, and *I(n)* is the impulse reply of windowing.

Clipping Factor

The clipping factor plays the main role in the CF method. It cuts the peaks of each signal over the threshold. This operation reduced the effect of the PAPR on the OFDM signal. So, it must be careful when this threshold had been taken as shown in Figure 4 in which the peak values had been cut. Part (a) shows the original signal, while part (b) shows the signal with a clipping factor equal to 30% of the original signal. Part (c) shows the signal with 50% clipped.



(a)

(b)

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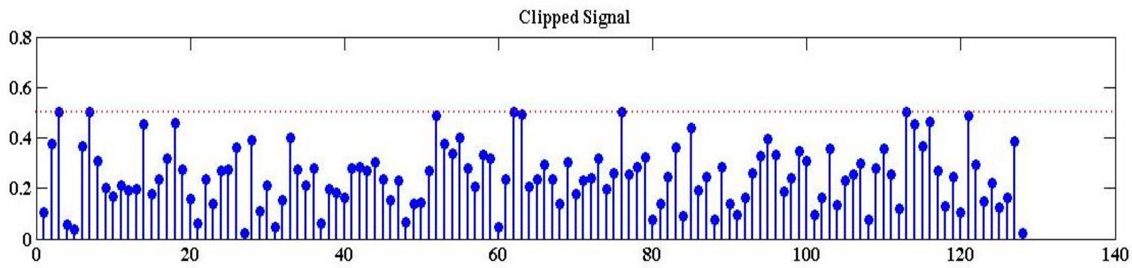

(c)

Figure 4. Signal and Clipping a) Original signal. b) Clipping of 30%. c) Clipping of 50%.

BER with SNR

The type of modulation has a significant effect on the transmitted signal. Obvious from Figure 5, that BPSK is the greatest type of modulation used to send and receive the image, specifically when SNR=10dB and greater, depending on the application of the algorithm many times to change the value of SNR. Increased value of SNR caused by increasing the power of the signal, leads to BER reduction. Another choice will be QPSK and 8PSK. So, the BPSK is the most robust of all types of PSK modulation because the highest level of noise was taken (or distortion) to make the demodulation achieve a mistaken choice.

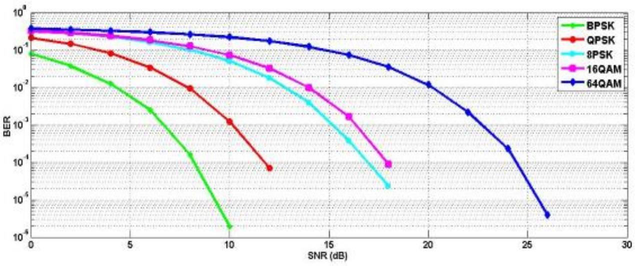

Figure 5. BER for multi-SNR values.

Modulation with PAPR

Modulation is a method of data conversion into radio waves using adding information to the electronic signal. In this work, the type of modulation plays a main role in influencing the value of PAPR, which is used to transmit an image through a channel using OFDM. From Figure 6, there are differences among each curve which represent a different type of modulation, whether the curve of PAPR with or without clipping including filtering.

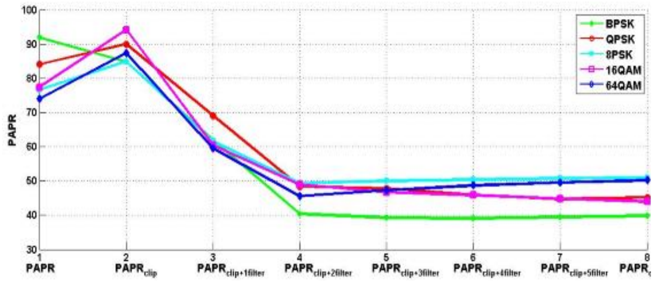

Figure 6. PAPR with and without clip with respect to filter stages in different modulation types.

Complementary Cumulative Distribution Function (CCDF)

CCDF is a method to calculate the statistical power in the time domain only. It supplies an understanding of immediate power across time. The curve of CCDF helps the designer of a power amplifier to design a power amplifier in a more useful way, noting the power change over time. The X-axis of the CCDF curve has a power in dB, while Y-axis represents the unit percentage. The power at X-axis is proportional to the signal's average power which takes the 0dB as the average power of the signal. If 3dB was taken as an example at 20 percent, it means that the probability of 20 percent of the power signal has been 3dB or more over the average power. Also, the curves give the peak-to-average power data required by the designers of the component. Also, the type of modulation has the main part to get the value of CCDF, as mentioned in Figure 7.

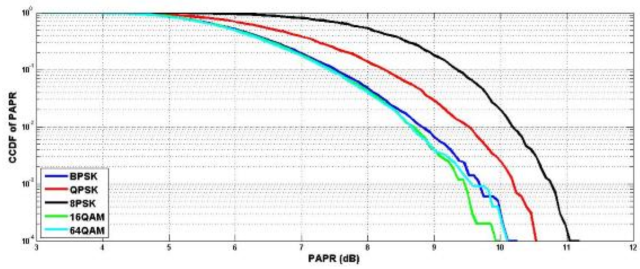

Figure 7. CCDF of PAPR with different modulation type

CONCLUSIONS

This article studied the structure of Orthogonal Frequency Division Multiplexing (OFDM) with the transmitter and receiver system, and the algorithm in the noisy evanescent channel was used for image transmission and reception to see the average peak power ratio (PAPR) effects. Since bit error rate (BER) is the highest significant performance of an OFDM system, simulation and discussion were mainly executed with different modulation types and different SNR values. BER and SNR show perfect results when BPSK is selected. The type of modulation is also considered control over transmission and reception. A major disadvantage of the system is PAPR, there are many techniques to minimize it, but the simplest technique is slicing and filtering. The most significant problem is that if you increase the number of subcarriers to see PAPR effects, the system quantity is greatly discredited, and the efficiency of spectrum use is reduced. When the image is transmitted from one place to another, BPSK is the ideal modulation type, followed by QPSK and 8PSK when referring to the simulation results. It was reached that the set of PSK is preferred over the set of QAM modulation. The clipping factor is also important, but it must consider the accuracy of the signal. So, it should make a balance between the value, to get the best way to transmit an image from the transmitted side to the recipient with the lowest possible PAPR effect. Due to the problem of PAPR which every OFDM system suffers badly from, a new algorithm was proposed to decrease it. As proved by the results and figures, and by making the balance between the number of using a filter with the accuracy of the signal, our proposed method is great and reduces the effect of PAPR, as explained in the figures.

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