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Histogram Security Test Analysis for BER and SNR in a Crypto OFDM System

Sanskriti Sharma[1], Dr. Manoj Kumar Nigam[2]

[1]Research Scholar, [2]Professor
[1,2] ETE department, MATS University Raipur
[1]sanskriti04sharma@gmail.com

Abstract

The topic of channel estimation in OFDM systems is addressed in part of this research study. Given to its dynamic character, the proposed framework provides quick resolution and hence lowers the complexity of channel estimates with reduced BER when compared to standard techniques. The outcomes show that when comparing to the usual encryption algorithm, the suggested techniquebased channel prediction technique with (Tx-Rx= 2x2) achieves a lower BER. As a result, this method is effective in lowering the signal error rate. Similarly, the proposed method's efficiency was found to be significant for other performance measures such as SER and throughput. This study is built on a method that uses the crossover and mutation operators to identify images with fewer interference and noise. In less rounds, the suggested method achieves a global optimum result. The findings obtained for the proposed technique with (Tx-Rx= 2x2) are noteworthy in terms of propagation delay. Although a lot of users are available, the proposed allocation of resources methodologies lower overall transmit power and assign the optimal bit, power, and subcarriers more quickly than earlier algorithms. With substantial throughput, BER and SNR, the proposed technique offers the best option for bit and power allocation of resources

Keywords: SNR, BER, OFDM, Optimal bit

Introduction

OFDM is a form of multi-level modulation. The OFDM signal is constituted by several tightly modulated mountains. When the modulation of any form of voice, data, etc. The receiver will be able to obtain the entire signal to demodulate the data successfully. As the result, when the signals are transmitted near the other, they must be arranged so that the receiver can separate them with the filter and should be a safety guard between them. It is not, with OFDM. Although the sidebands of each carrying overlap, they can be obtained without interference that can be expected because they are perpendicular to each other. This is realized, having a mutual period symbol. Tradition allocation, if signals on the different room’s Traditional selection if signals on different channels to see how OFDM works, you need to look at the receiver. This acts like a bank of demodulators, translating each carrier into direct current. The resulting signal is integrated into the symbol period to regenerate the carrier data. The same demodulator also demodulates the other carriers. Since the carrier spacing equal to the inverse of the symbol period means that they will have an integer number of cycles in the symbol period and their contribution will add to zero i.e., 'there is no interference contribution. division, showing how the sidebands of adjacent carriers cancel out at the point of the main carrier’s Basic concept of OFDM, orthogonal frequency division multiplexing A requirement of OFDM transmitting and receiving systems is that they must be linear Any non-linearity will cause inter-carrier interference due to inter modulation distortion. This will introduce unwanted signals which will cause interference and compromise the orthogonally of the transmission. In terms of the equipment to be used, the high peak-to-average ratio of multi-carrier systems such as OFDM requires the RF final amplifier on the transmitter output to be able to handle spikes while the average power is much lower, and this leads in some systems the peaks are limited. Although this introduces a distortion which results in a higher level of data errors, the system can rely on error correction to remove them. Data over OFDM The traditional format for sending data over a radio channel is to send it serially, one bit at a time.

This is based on a single channel and any interference on that single frequency can interrupt the entire transmission. OFDM takes a different approach. The data is transmitted in parallel on the different carriers in the overall OFDM signal. By being split into several parallel "sub-streams", the overall rate is that of the original stream, but that of each of the secondary streams is much lower and the symbols are more spaced out in time.

1.1 Second Generatıon (2G) Technology

GSM stands for "Global System for Mobile Communications" and is a second-generation wireless phone technology. Other than digital audio, it cannot send or receive data like as email or software. For some standards, however, SMS texting is an option for data transport. In 1991, the GSM standard was used to create commercial 2G cellular communication networks. Over 2 billion individuals utilize the GSM service in over 212 nations and territories. The GSM standard makes international roaming amongst mobile phone operators relatively prevalent, allowing customers to use their phones in many different parts of the world. 2G technologies are classified as either TDMA (Time Division Multiple Access) or CDMA (Code Division Multiple Access) based on the type of multiplexing employed. A Compression Decompression (CODEC) Algorithm is used in 2G networks to compress and multiplex digital voice data, allowing a 2G network to pack more calls per unit of bandwidth than a 1G network. Because they emitted less radio power, 2G mobile phones were often smaller than 1G phones.

1.2 Thırd Generatıon (3G) Technology

3G refers to the third generation of mobile phone technologies, which is located between 2G and 4G.

It is centred on the International ITU family of standards, namely the International Mobile Telecommunications-2000 initiative of the International Telecommunications Union (IMT-2000). Through enhanced spectral efficiency, 3G technology allows network operators to provide users with a broader selection of more advanced services while also increasing network capacity. Wide-area wireless phone telephony, video calls, and broadband wireless data are all available in a mobile setting. Further characteristics such as High-Speed Packet Access (HSPA) data transfer capabilities can give downlink and uplink speeds of up to 14.4 Mbps and 5.8 Mbps, respectively. The quantity of information that can be sent over a given bandwidth in a digital communication system is referred to as spectrum efficiency. HSPA is a set of mobile telephony protocols that improve on and extend the capabilities of existing Universal Mobile Telecommunications Systems (UMTS) standards.

1.3 Fourth Generatıon (4G) Technology

The fourth generation of cellular communication protocols is known as 4G. It is the successor to the 3G and 2G standards families. It is a 3G technology extension with increased bandwidth and service offerings. The main expectation for 4G technology is high-quality audio/video streaming over an andto-end Internet Protocol connection.

Summary of Literature Survey Done

The comprehensive study of literature reveals that various academics have conducted extensive research in the area of PAPR reduction in multicarrier modulation schemes. Researchers offered a number of PAPR reduction strategies, including clipping, interleaving, SLM, PTS, coding techniques, pulse shaping, and various combinations of the aforementioned, to lower the PAPR of the transmissions in OFDM signals. None of the strategies presented provides good PAPR reduction, high coding rate, and low computation complexity at the same time. As a result, in the current work, an effort was made to strengthen the PAPR reduction in OFDM and MIMOOFDM systems by using a modified partial transmit sequence with four phase factors and adjacent dividing up, as well as parallelization and pulse shaping methods, to enhance the MSE and BER performance of these systems.

Methodology Used

The AES algorithm is at the heart of our suggested cryptosystem. A user of AES generates and then releases their public key, which is the product of two huge prime integers plus an auxiliary value. The most important aspects should be completely hidden. Anybody could encrypt a message using the public key, however if the public key is sufficiently high, maybe someone who knows the prime factors could decrypt the message using presently available techniques. Shift ciphering is a symmetric key cryptography procedure that employs a shared key for both decryption and encryption (the cypher alphabet is the plain alphabet rotated by a certain range of positions). The ASCII characters are replaced with numbers ranging from 0 to 127 and moved as per a key. The shifted numbers are communicated, and the original values are recovered at the receiving end by shifting with a key that is shared by the transmitter key. The following are some of the benefits of (Public Key Cryptographic) PKC: (1) Eliminates the constraint of two parties sharing a symmetric key. (2) The PKC has the following drawbacks: (1) it is more complicated and used for short messages; (2) it decreases the number of keys necessary; (3) it is very difficult to crack the code; and (4) it is highly complicated and is used for short messages. (2) the user's public key authentication [27-30]. As a result, we've studied the benefits of both (Symmetric Key Cryptographic) SKC and PKC, as well as their drawbacks.

a

(a) (b)

(c)

Figure.1 (a) (b) and (c) Input images used for Proposed Methodology

Proposed work wıth symmetrıc algorıthm:

Step 1: Set all network parameters to their default values.

Step 2: Choose an image and encrypt it.

Step 3: Use Bit Stream to disperse the data.

Step 4: Nyquist Quadrature. Signals should be modulated.

Step 5: Transform the serial code stream to concurrent format.

Step 6: Insert the chaotically modulated signals in the OFDM sub-carriers.

Step 7: Applying IFFT, locate the symbol time waveform.

Step 8: Per each symbol time waveform, insert a cyclic prefix.

Step 9: Frame-by-frame transmit the signal

Step 10: AES is used to simulate the channel.

Step 11: Wait for the signal frames to arrive.

Step 12: Determine the symbol's spectrum.

Step 13: Using the symbol spectrum, retrieve the utilized carriers.

Step 14: Transform the parallel code stream to serial format.

Step 15: Use the Viterbi decoding algorithm to decode the signal.

Step16: Applying the same Bit stream, de-spread the data.

Step 17: Obtain data and decrypt it

Step 18: Determine the BER from the data you've obtained.

Step 19: Make a graph of the results.

Table 1 Different Image Comparisons for SNR and BER without Encryption

Images	**SNR [35]**	**BER [36]**
	-0.00032811368118520443	-1523.8620900960664
	-0.00040274752566193587	-1241.4725557363133
	-0.0004387023615591339	-1139.7248882431732

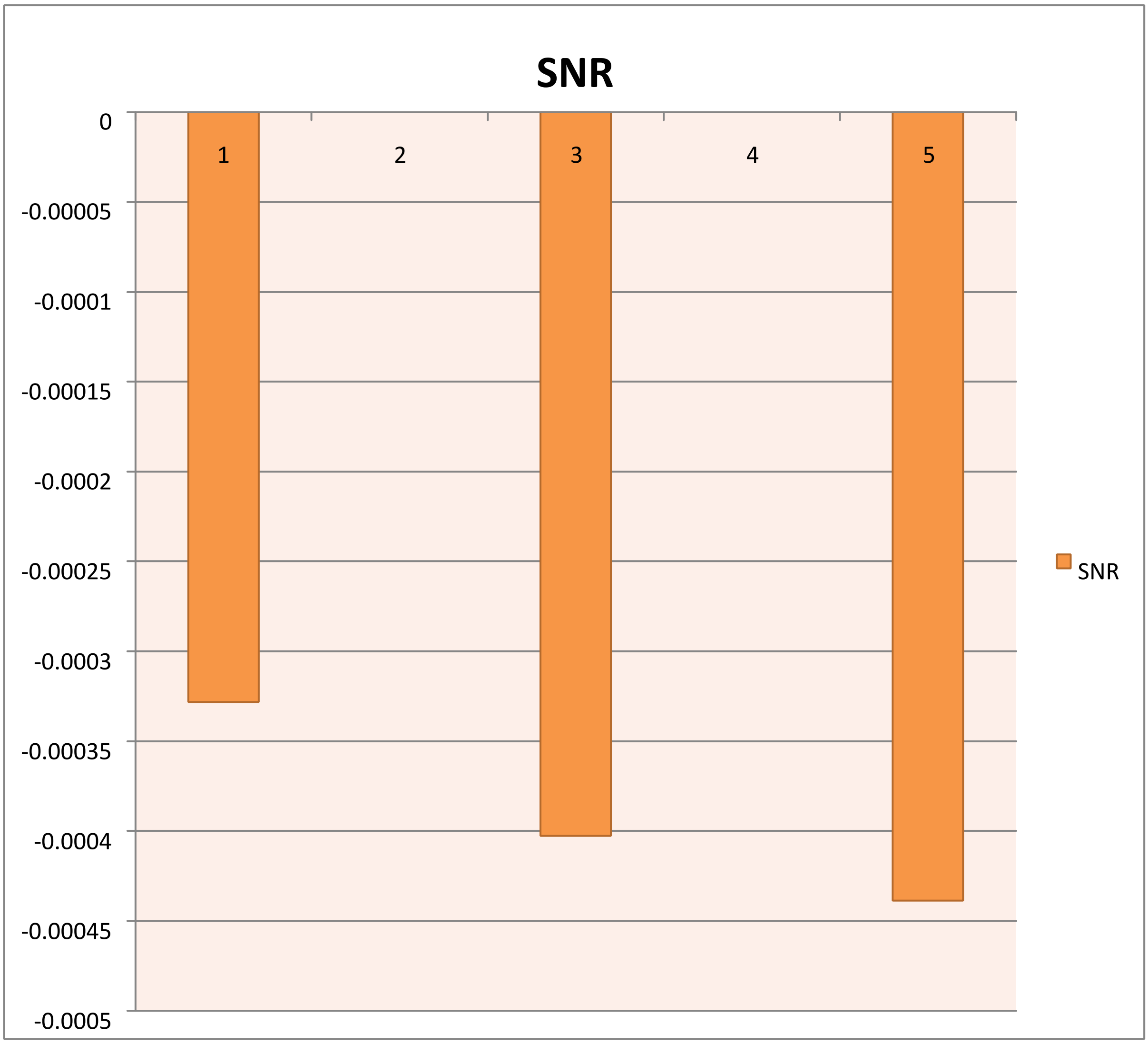


Fig 2 Different Image Comparisons for SNR without Encryption

3.1 Security Analysis

In JCMA, the joint constellation at the receiver's MF output is the result of a coherent sum of the transmitter BB symbols and is unique to the location of the transmitters and receiver in space. This is achieved due to the individual compensation of delay, phase, and attenuation of each transmitter. the receiver's joint constellation would always be the same and the bit mapping from the transmitters to the joint symbols would be known a prior to the receiver. Since an eavesdropper would naturally occupy a different location in space, the transmitters BB symbols would create a different joint constellation than that of the receiver. This is practically always true even when the eavesdropper is close to the receiver because the wireless channel decorrelates fast in space. A distance of a few carrier wavelengths apart (a few centimeters for frequencies of the order of GHz) decorrelates the channel almost completely [33]. It follows that the eavesdropper would have no a prior knowledge of the bit mapping from transmitters to joint symbols. This is the basis for achieving information theoretic security.

3.2 Information Theoretic Security

The pilot from the receiver invokes key generation and distribution from the wireless medium to the transmitters. This key is the channel estimates at the transmitters. Each part of the key is known exclusively at each transmitter. In accordance with the Shannon secrecy model and its notation in [34], the message ￼ as defined in [34] corresponds to the vector of transmitted symbols across the transmitters. This joint message is encrypted by the transmitters—each transmitter transforms its symbol by scaling and rotating it with the key. So ￼ in [34] corresponds to the vector of channel estimates at the transmitters. For the receiver's location in space, the channel itself performs a deciphering operation by rotating and scaling the encrypted message back to the original ￼. For the eavesdropper location in space the channel performs another enciphering operation with another key ￼, being the channels from the transmitters to the eavesdropper location. The eavesdropper constellation point ￼ corresponds to the cryptogram ￼ in [34]. The eavesdropper has to decipher ￼ from ￼ using all possible prior knowledge, such as the offline-determined transmitters BB symbol sets, the channel statistics, and the prior probabilities of the messages ￼.

3.3 Summary Of Review

Despite using standard modulation algorithms, the suggested modulated and demodulated pictures are encrypted using the OFDM system's IFFT and FFT techniques, which exhibited a marked enhancement in security. To protect the data transmitted utilizing OFDM system, we used the AES, Triple DES, and Cha Cha20 ciphering algorithms, and so this system has also been proven secure. We employed the AES Triple DES and Cha Cha20 ciphering algorithms for both modulation and demodulation in our suggested method. As a result, the proposed strategy is predicted to provide higher security while sacrificing minimal in terms of SNR vs. BER performance.

Simulation Environment

Simulations are conducted out using OFDM technology. A 64-point IFFT is used to create technique for an image, which has a 16-character cyclic prefix. Across all sub-carriers, the approaches were utilized as the modulation strategy. Furthermore, training symbols with unit energy for every subcarrier are sent and used for channel estimation at every location, with the least-square (LS) channel estimators used at all nodes in the network. The prediction analyses of the shared medium and eavesdropping channel, and the noise levels of power throughout all nodes, is adjusted to be much like in order to determine a valid assessment. Furthermore, both the legal receiver and the eavesdropper are believed to have flawless encryption.

4.1 SNR Performance

We obtain the SNR and BER expressions for downlink OFDM systems in noisy decaying Doppler channels throughout this section [44]. The SNR of the mth subcarrier is calculated as follows:

SNRm =PDm

PIm+PNm

Where PDm is the average power of the desired signal, PIm is the average interference power and PNm is the average noise power. The average power of the desired, interference and noise is efined a PDm = E |Dm |2, PIm = E |Im |2, and PNm = E |Nm |2 respectively [45]. Hence, the average SNR on the mth subcarrier is formulated as:

SNRm =E[|Dm

E [|Im+Nm|2]

4.2 BER Performance

The results of these secure OFDM systems were evaluated using different systems to highlight the influence of security on the BER performance. It is obvious from the results that the improvements acquired by the AES over alternative secure and unsecure OFDM systems. At a bit error rate of (1*10-4) as a comparison, the safe system using the RC4 stream cypher will require 1.5 more dB to attain the same efficiency as the AES cypher, however the benefits gained increased to around 1.9 dB when brought in comparison to the traditional system .

4.3 Crypto - OFDM System

A crypto-OFDM system is a normal OFDM system with additional system components, an image encryption block on the source side, and a decryption block on the destination end.The encrypted image IENC can be represented as follows:

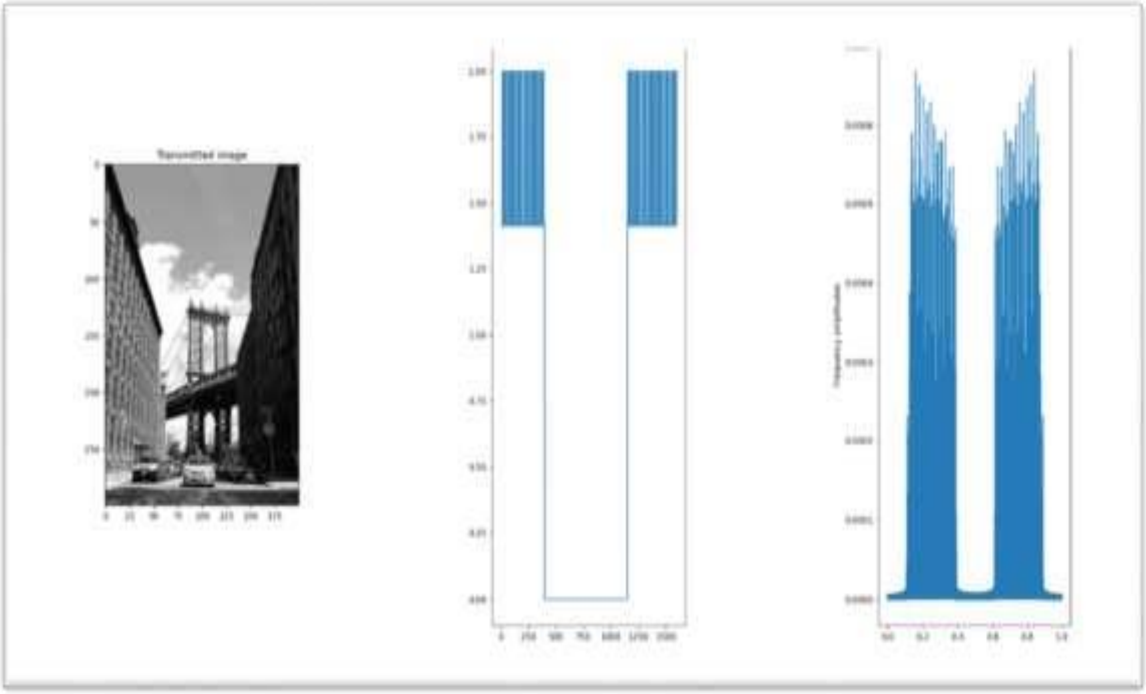
IENC = E(I,K) (1)

The source picture is I, the encryption algorithm is E, the cypher key is K, and the cypher image is IENC. An unencrypted image is first converted to a parallel stream of data, which is then changed into a multilevel complicated sequence using one of several modulation algorithms. To transform complicated patterns into OFDM signals, the inverse fast Fourier transform (IFFT) is used.The modulated OFDM signal would then be routed over an additive white Gaussian noise (AWGN) channel that has been modelled [47]. The signal s(t) obtained is written as s(t) = x(t) + u(t) (2)

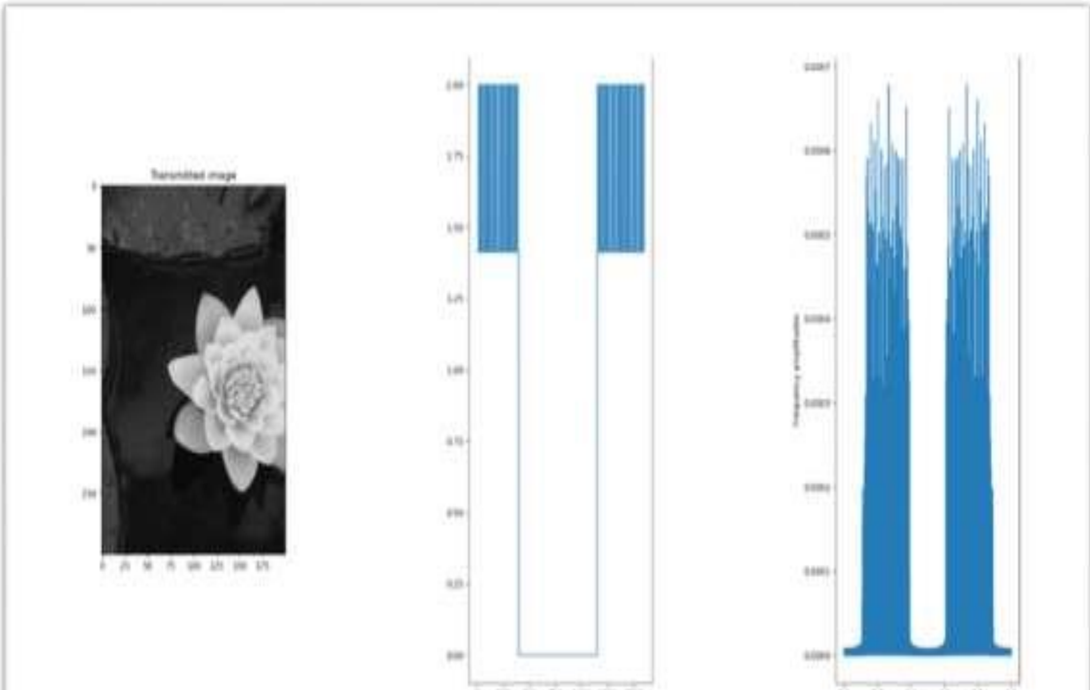
In (2), x(t) represents modulated signal, s(t) is the received signal, and u(t) is the AWGN with power spectral density .

Histogram Test Result

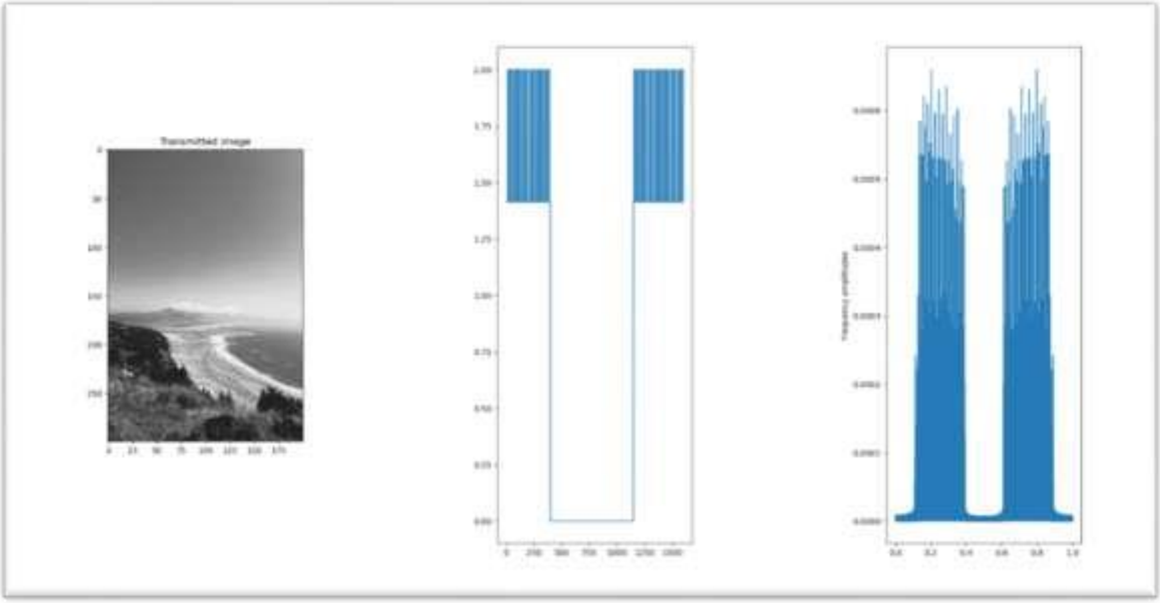
The dispersion of intensity levels in an image is represented by the histogram. The intensity distribution of 256 levels is symbolically represented by a histogram in an 8-bit grayscale picture[49]. The consistency of an encrypted image's histogram renders the encryption system more resistant to various attacks. The Bridge Road in both its actual picture and its OFDM encrypted form. When brought in comparison to the actual image, which is random, the histogram of an encrypted image has a consistent appearance The image is more secure due to the regularity of the tonal distribution.



(a)



(b)



(c)

Fig 3 (A), (B) And (C) Shows The Output For The Input Images

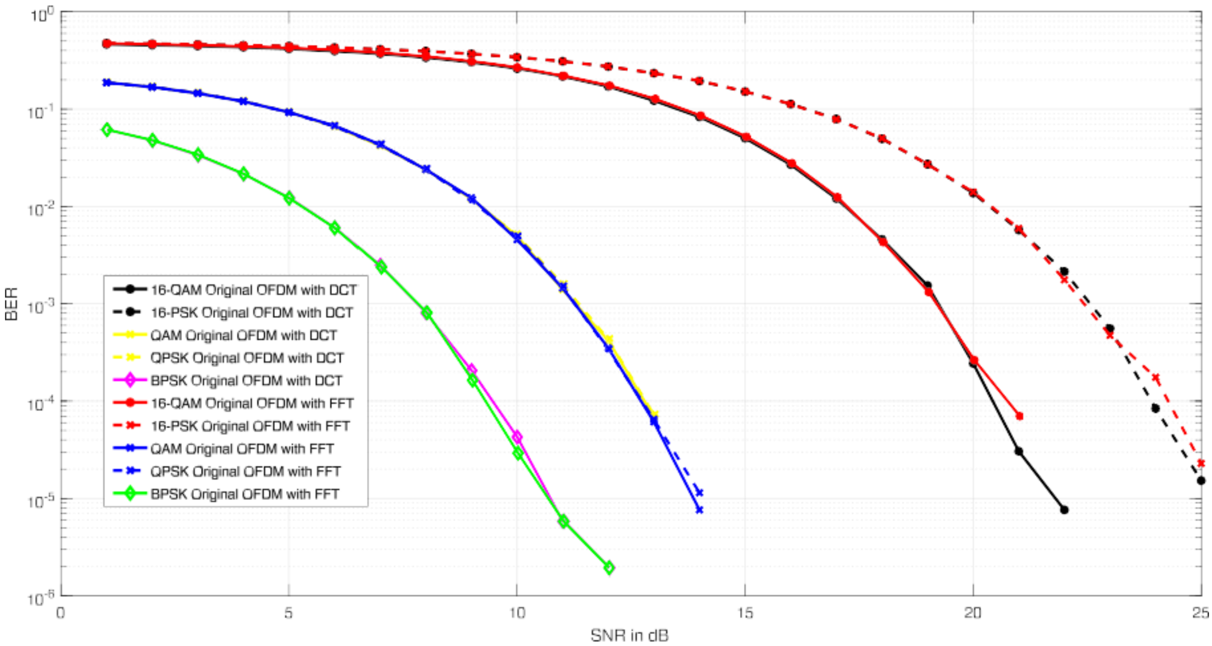


Fig 4 BER versus Snr Plots of Bridge Image for an Original OFDM System (FFT And DCT) With Different Modulation Schemes

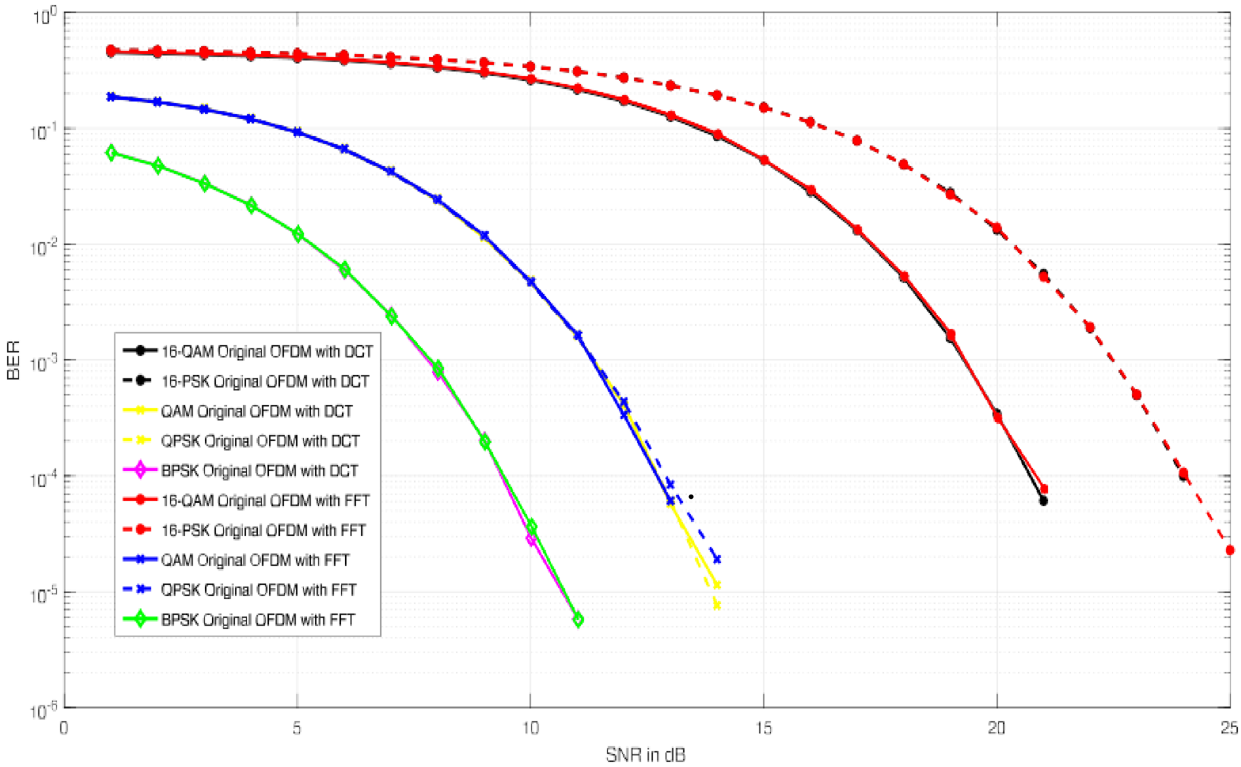


Fig 5 BER Versus SNR Plots of Road Image for an Original OFDM System (FFT and DCT) with Different Modulation Schemes

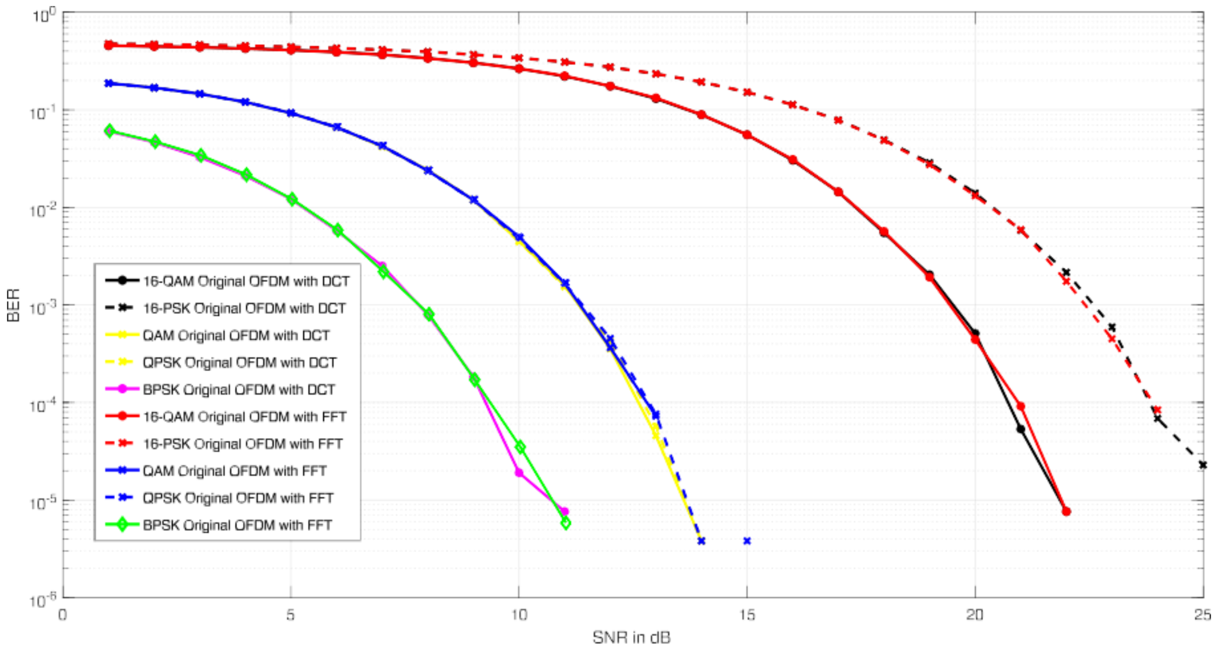


Fig 6 BER Verus SNR Plots of Flower Image for An Original OFDM System (FFT And DCT) With Different Modulation Schemes

As for three restored Bridge, Road, and Flower images, this shows the variations of the BER with SNR for original FFT/DCT-OFDM devices with large modulation schemes (BPSK/QPSK/QAM/16PSK/16-QAM). In these statistics, it can be shown that as the SNR increases, the BER values for the retrieved image improves. When the BER number approaches infinity, it indicates that the mean square error among sent and retrieved images is zero, implying that the recovered image has the same quality as the original. DCT-based systems, in comparison to other systems, attain a greater BER magnitude. The DCT is more profitable than the FFT for picture data because it concentrates energies on lower-order coefficients. The DCT's SNR quality will be outstanding, resulting in increased bandwidth efficiency in manufacturing.

Conclusion

The current study was primarily concerned with boosting the effectiveness of OFDM systems by utilizing various encryption techniques. Channel estimation, multi-user detection, and distribution of resources are among the main issues of OFDM systems, and approaches relying on swarm intelligence approaches are offered.The topic of channel estimation in OFDM systems is addressed in part of this research study. Given to its dynamic character, the proposed framework provides quick resolution and hence lowers the complexity of channel estimates with reduced BER when compared to standard techniques. The outcomes show that when comparing to the usual encryption algorithm, the suggested technique-based channel prediction technique with (Tx-Rx= 2x2) achieves a lower BER. As a result, this method is effective in lowering the signal error rate. Similarly, the proposed method's efficiency was found to be significant for other performance measures such as SER and throughput. This study is built on a method that uses the crossover and mutation operators to identify images with fewer interference and noise. In less rounds, the suggested method achieves a global optimum result.

The findings obtained for the proposed technique with (Tx-Rx= 2x2) are noteworthy in terms of propagation delay.Although a lot of users are available, the proposed allocation of resources methodologies lower overall transmit power and assign the optimal bit, power, and subcarriers more quickly than earlier algorithms. With substantial throughput, BER and SER, the proposed technique offers the best option for bit and power allocation of resources.

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