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Implementation of Omar Pigeon Space-Time (OPST) Algorithm to Mitigate the Interference and Peak-to-Average Power Ratio (PAPR) Using RPR Mobile and HST-HM in the 5G

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ABSTRACT

Nowadays, the 5G parameters play an eminent role in the massive Multiple-input, multiple-output orthogonal frequency-division multiplexing (MIMO-OFDM) system for enriching high signal to noise ratio (SNR). 5G application has emerged in the role of artificial intelligence for involving the reduction of Peak to Average Power Ratio (PAPR) and Bit Error Rate (BER). In MIMO – OFDM system, the high PAPR is a tremendous drawback during the transmission of bit symbol with the number of sub-carriers in the signal. To avoid Intercarrier Interference (ICI) during transmission of the number of sub-carriers, the Omar Pigeon Space-Time (OPST) algorithm is implemented. Then, to overcome high PAPR in the uplink, the Hybrid Space-Time - Hadamard matrix (HST-HM) techniques are proposed and the Bit Error Rate (BER) is decreased abruptly. 5G parameters and specifications are incorporated in this OPST algorithm for avoiding interference during the data bit transmission in the MIMO – OFDM system. Realtors Property Resource (RPR) mobile app is developed for an experimental display of the information that occurs in the real-time uplink MIMO – OFDM system. Thus, the descriptive analysis and simulated results of PAPR, SNR, and BER are executed using the proposed system of HST with HM in the 5G Communication. The RPR mobile executes the outcomes through the OPST algorithm with a better system performance of the MIMO-OFDM system based on the 5G.

1. INTRODUCTION

MIMO supports the antenna channel which improves the capacity for several signal paths, but also achieves better throughput in the existing uplink and downlink. It preserves multiple numbers of signals through the channel with the matrices as 2×2, 4×2, or 4×4 antenna. The MIMO system helps to increase the efficiency of the channel, then to measure the performance of the system at a dominant level for 4G. Moreover, it attains the spectral efficiency to calculate the multiple numbers of transmitting antennas and multiple numbers of receiving antennas through the channel without any occurrence of fading.

OFDM is known as multi–carrier modulation or multiplexing technique, because the capability to utilize multiple subcarriers in the same channel without interference. A number of sub–carriers are arranged closely spaced orthogonal to each other in parallel transmission. Mainly, the subcarriers follow orthogonal to each other and provide the subcarrier spacing as $\nabla f = k/T_s$, k=the positive integer and T_s=symbol duration. Each subcarrier is involved to reduce interference and overlapping. It describes the symbol rate modulation method for obtaining less ISI, which is caused by the multipath propagation. The main objective of the OFDM is to transmit the high data stream within a single subcarrier and simultaneously reduce interference. The ICI and ISI are shown in Figure 1.

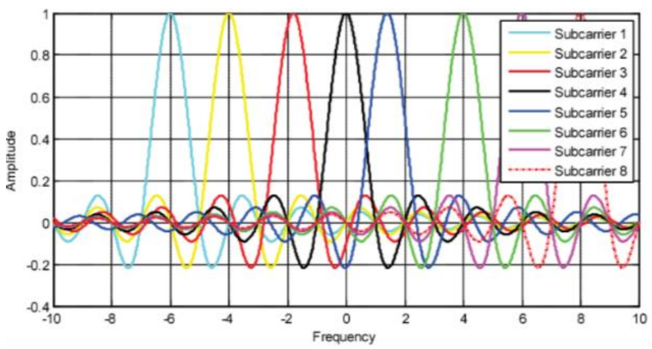

Figure 1. Intercarrier Interference (ICI) and Intersymbol Interference (ISI)

It attracts many subcarriers, which enables the data bit to travel through the Quadrature Amplitude Modulation (QAM) within a low symbol rate. The OFDM follows three important ways for transmitting the data information, such as (i) the multiple carriers are commonly called subcarriers for transmitting data stream, (ii) subcarriers always follow orthogonal to each other (iii) Cyclic Prefix (CP) is inserted in the OFDM system to reduce the Inter Symbol Interference (ISI) and decreases the delay spread in the channel [1-3].

2. MIMO – OFDM SYSTEM WITH LTE

The spectral efficiency provides high compatibility in the MIMO-OFDM system, then it supports less ISI. The system consists of OFDM modulation and demodulation for operating the Inverse Fast Fourier Transform (IFFT), which converts the frequency domain to the time domain and Fast Fourier Transform (FFT) converts the time domain to frequency domain. The Spacetime coding (STC) is used for encoding the data bits from serial to parallel with the OFDM modulation. The specific process of the STC is to perform the better reliability of transmission of data in the communication system. Actually, the STC have multiple transmission, which involved three steps (i) the redundant data stream are transferred to the receiver. (ii) Bothe the transmission and reception allows the data to perform reliable decoding. (iii) It demonstrates the distribution of the coding gain and diversity gain for the MIMO-OFDM system. STC helps to decrease the fading in a frequency selective channel [4-7]. The main objective of the MIMO – OFDM system is to improve the channel capacity through the transmitting MIMO antenna (1 to Nt) and receiving MIMO antenna (1 to Nr), which is shown in Figure 2.

The data input bit (A_L) is passed to the STBC encoder is defined as follows Eq. (1).

$$A_L = A_0, A_1, A_2 \ldots \ldots \ldots .. A_{M-1} \quad (1)$$

The length of the bit (L)=0, 1, ..., N.

The common OFDM system is defined as equation in Eq. (2).

$$c(t) = 1/\sqrt{N} \sum_{j=0}^{M-1} A_L \, e^{j2\pi L f_0 t}, 0 \le t \le T \quad (2)$$

where, T=interval of the symbol, f_0=1/T=frequency space.

When the encoded data is passed to the IFFT, then the discrete-time version of the complex vector is measured in Eq. (3).

$$c(n) = 1/\sqrt{N} \sum_{j=0}^{M-1} A_L \frac{e^{j2\pi L_n}}{KN} \; 0 \le n \le KN\text{-}1 \quad (3)$$

where, k=represents the oversampling factor. The MIMO space-time encoding is the converted input data stream as:

$$X1(n,k), X2(n,k) \; \ldots \ldots XN\,(n-k) \quad (4)$$

The data input is transmitted through the STBC to the OFDM modulator with Eq. (4), then to the transmitting MIMO antenna through the channel [8]. In the same way, the output sequence of the OFDM demodulator is calculated by the MIMO space-time decoding as given in Eq. (5).

$$Y1(n,k), Y2(n,k) \ldots . YN\,(n-k) \quad (5)$$

The output sequence of data sink is generated in the STBC MIMO – OFDM system is given in Eq. (6).

$$B_L = \frac{1}{\sqrt{2}} [H][A_L] + [n] \quad (6)$$

The basic PAPR formula for SFBC -PTS system as existing is given in Eq. (7) and Eq. (8).

$$PAPR(X[n]) = \frac{0 \le n \le \underset{LN-1}{MAX}(x[n]^2)}{E(x[n])^2} \quad (7)$$

$$x[m] = \frac{1}{\sqrt{N}} \sum_{k=0}^{N-1} C_k \, e^{\frac{j2\pi nk}{LN}}, 0 \le m \le LN-1 \quad (8)$$

The parameter used is Peak to Average Power Ratio (PAPR), which is defined as a ratio between the peak power (PP) and average power in the input signal. To provide the efficient performance of the system, a PAPR must be less in the MIMO-OFDM system. This input sequence is derived from Eq. (8) and the output existing SFBC – PTS sequence is derived from Eq. (9), Eq. (10), Eq. (11).

$$X = \sum_{v=1}^{V} b_v \, C_v \quad (9)$$

$$\mathrm{x} = IFFT(X) = \sum_{v=1}^{V} b_v X_v \quad (10)$$

$$b_v = e^{j\varphi v} (\varphi_v[0, 2\pi]) \{\text{v=1,2,3,.......X}_v\} \quad (11)$$

The input of the STBC -PTS system in the time domain is in Eq. (12) for the existing system.

$$s(\mathrm{t}) = \frac{1}{\sqrt{N}} \sum_{k=0}^{N-1} S(k)\, e^{\frac{j2\pi nk}{N}} \quad (12)$$

The enhanced output sequence of the STBC with PTS is shown in Eq. (13).

$$E(n) = \sum_{v-1}^{V} s_i b_v b_{il} \quad (13)$$

$$PAPR(X[n]) = \frac{0 \le n \le \dfrac{MAX}{LN-1}(E[n])^2}{E(E[n])^2} \quad (14)$$

Thus, the STBC method is used to decrease the peak value and the Error Rate (BER), which are obtained through the Additive White Gaussian Noise (AWGN) channel of the receiving MIMO antenna and the Peak -to-Average Power Ratio output for the Enhanced STBC - PTS is given above Eq. (14).

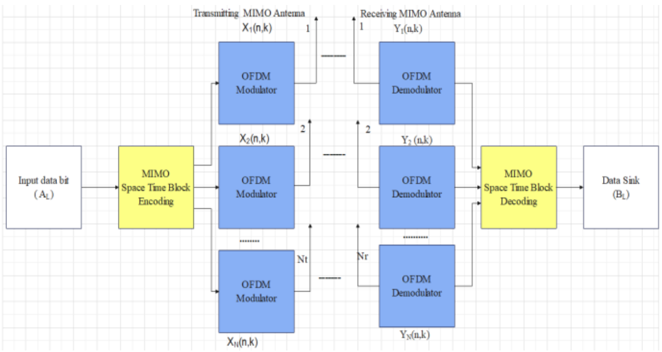

Figure 2. Block diagram of MIMO – OFDM system

In 2016, the PAPR value is reduced up to 2.6 dB, 3.1 dB, and 3.6 dB for CCDF = 10-4 by using Space Frequency Block Coding (SFBC). Then, SFBC is combined with the Partial Transmit Sequence (PTS) to reduce the PAPR value in the ratio of 6.25 dB, 5.28 dB, and 4.95 dB, respectively. In 2017, the proposed STBC with EABC-PTS reduces the PAPR as 4.5 dB, 4.3 dB, and 3.5 dB. The BER is obtained to be decreased up to 10-6 by increasing the SNR as 10 dB. Basturk and Ozbek, 2016 investigated and defined the complexity of the STBC-OFDM system with their parameters such as BER performance as $10^{-3.6}$ and the Mean square Error (MSE) $10^{-4.5}$ for 64-bit QAM modulation. In STBC -EABC – PTS, the optimal phase factor has been removed and the PAPR is minimized for the number of Sub – carriers as 128 dB, 256 dB, and 512 dB in the MIMO - OFDM system [9-12]. In 2018, Yasir Amer proposed the Gray-PF-PTS algorithm to find the 5G waveform performance for maintaining the PAPR value based on the Filtered – OFDM (F – OFDM).

Mostly, HT is included in the data sequence between the autocorrelation for reducing the PAPR[13]. It is generated in the N order of matrix for the recursive procedure during the data transmission. Finally, 5G is the best suitable specification to implement for the PAPR reduction in the MIMO – OFDM system. 5G waveform works very fast than the 4G, by assisting to reduce the interference and noise in the mobile communication application [14, 15].

A Prolong rate of communication in wireless technology is moving very tremendous for high-speed internet in many real-time applications. In olden days, wireless communication is facing with enormous demand in high-speed data transmission, due to interference from multiple propagation effects. Firstly, the Long-Term Evolution (LTE) is the fourth generation (4G) technology that develops the speed of the data rate up to 20 Mbps for accessing multicarrier system technology is known as Orthogonal Frequency Division Multiplexing (OFDM). Another new technology in LTE is Multiple Input Multiple Output (MIMO), which improves the high capacity of the antenna in the wireless channel. Both these technologies play an important role in LTE for transmitting high data speed during communication and enabling multiple transmitter and receiver data simultaneously.

4G has the capability of high-speed mobile communication with maximum data rate as 100Mbps and fifteen times faster and high capacity than the 3G. The important characteristics of an LTE are (i) efficient bandwidth for the uplink (50Mbps) and the downlink (100 Mbps), (ii) lower delay, and (iii) throughput. The drawbacks available in the LTE system are poor coverage signal, low signal strength during transmitting in trains and buses, high cost, and cannot utility for the old version of the smartphone. The main aspect of insisting on the MIMO-OFDM system of LTE is to further mitigate the PAPR after adding the cyclic prefix in the uplink. If the modulated subcarriers are independent in the OFDM system, then the peak value can be very high to be denoted as PAPR [16, 17].

5G is very hardly works for many of the researchers with high-speed data rate in industry and manufacturing environment. It supports to increase the frequency band with higher data rate for transmission of bits per second. Moreover, the coverage improves more than the long-term evolution with less latency for the different characteristics of the 5G application. The availability of 5G mobile communication utilizes the data rate, low latency, high spectral efficiency, and complexity of the MIMO-OFDM system to overcome the interference and PAPR. In 2017, the STBC with EABC algorithm is proposed to reduce the PAPR and BER, avoid the optimum phase factor problem, and reduce the computational complexity. The Hadamard transform (HT) is implemented to mitigate the PAPR for signal processing in the 5G application. The characteristics of the HT are accomplished in many block coding schemes to address the experimental techniques of the OFDM signal.

3. PROPOSED SYSTEM

This proposed work is to improve the signal strength by the transmission of data bits in the uplink, which is implemented by the parameters and specification of the fifth-generation (5G) supported by Artificial Intelligence (AI).

5G helps to provide faster speed. Lower delay and have capability to connect number of devices. Hence the AI insist the 5G for servicing on the cloud to analyze the data to work faster. AI will enable the machines and systems to manage with intelligence factors to the human factor. Main advantages of AI are null risk, reduction in human factor, resolve major issues, more creative etc.

The objective is listed below:

To evaluate the mitigation of interference, the Omar Pigeon Space-Time (OPST) algorithm is implemented between the Quadrature Amplitude Modulation (QAM) and the Inverse Fast Fourier Transform (IFFT) through RPR mobile app.

To investigate the reduction of PAPR values, the combined Hybrid Space-Time Hadamard matrix (HST- HM) techniques are used with the different number of subcarriers such as 512 and 1024 for modulating the sequence of data bits in the MIMO-OFDM system.

To examine signal-to-noise ratio (SNR) for increasing values in the order of 30 decibels (dB), higher than 4G. The Bit Error Rate (BER) in the downlink is lower as 10- 6 to 10-7 due to the specification of 5G.

To reduce the latency of space and time due to OPST algorithm, an RPR mobile app is used to intimate the completion time of the transmitted data bits on an orthogonal number of subcarriers of system. The existing system is facing with a critical drawback in communicating the input data bits with the number of subcarriers for transmission in the uplink. The problem statement of this proposal is

Introduced the Inter-Carrier Interference (ICI) in between the number subcarriers and overlap each other.

Heavy Peak -to-Average Power (PAPR)

Increases the PAPR, SNR increases, and BER decreased in the downlink.

To overcome the Intercarrier Interference (ICI), the Omar Pigeon Space-Time (OPST) algorithm is proposed. The mathematical representation of the OPST is given in the equation [18, 19] for initiating the space time between the subcarriers. Further, the Realtor Property Resource (RPR) mobile research app is used to update the status of spacetime, several subcarriers are transmitted during data communication through the QAM and IFFT. These RPR mobile helps to display all outcomes after implementing the OPST algorithm. Mostly, it helps to support the real-time updation of the transmission of encoded input data with the specification of 5G as shown in Figure 3. Secondly, MIMO – OFDM system provides too high PAPR, i.e., due to the multicarrier system, the number of different subcarrier are not orthogonal to each other and, out of phase with each other [20, 21]. Hence, the Hybrid Space-Time – Hadamard Matrix (HST -HM) techniques are proposed to reduce the PAPR up to the mark. Once the PAPR is mitigated in the uplink, then Bit Error Rate is decreased and Signal -to-Noise Ratio (SNR) is increased in the downlink based on the 5G specification in the MIMO – OFDM System.

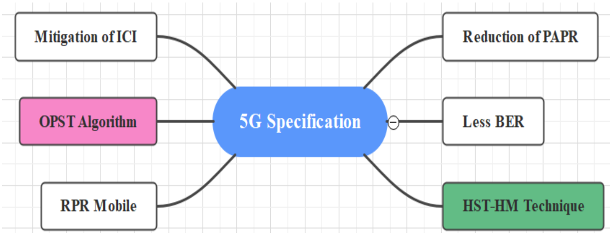

Figure 3. Structure of algorithm for reduction of PAPR and interference with 5G

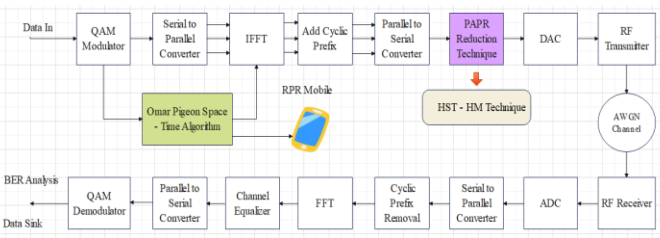

Figure 4. Block diagram of OPST and HST-HM techniques in MIMO- OFDM system

The block diagram of OPST and HST-HM techniques in the MIMO- OFDM system is shown in Figure 4. The total number of data bits (Db) is transmitted with the number of subcarriers (SC) through QAM to generate the output. The first data bits and the subcarrier with symbol duration are passed with the total number of subcarriers being reduced to half Nsc in the iteration.

It calculates the time delay between the two subcarriers to transmit in the event of the IFFT. The number of subcarriers with time duration is given in Eq. (15).

$$N_{st}(t) = \frac{N_{sc}}{2}(t-1) \tag{15}$$

The space, time, and distance must be updated for every ‘i’ at tth iteration during the data transmission as follows in Eq. (16).

$$L_{fp}(t) = \sum_{i=0}^{n} \frac{D_i(t).fitness\ D_i(t)}{N_{sc}\ \sum fitness\ (D_i(t))} \tag{16}$$

where, L_{fp}=Length of the first subcarrier, D=data bits.

The total number of iterations are added randomly to the length of the subcarriers to calculate the distance and space-time by implementing OPST in the RPR mobile display as given in the block diagram. The OPST algorithm is obtained in the methodology section. The input data is encoded and converted to the time domain samples to be subtracted to calculate the next iteration as given in Eq. (17).

$$X_i(t) = D_i(t-1) + rand\ L_{fp}(t) - D_i(t-1) \tag{17}$$

Thus, the OFDM symbol defines the quality number of the subcarrier, where the individual ‘i’ determine among the total number of subcarriers not to overlap to occur intercarrier interference [22]. Following the IFFT waveform, the cyclic prefix is added and converted from parallel to serial converter to calculate the peak value of the data bits. Here the PAPR value is to be calculated and determined.

The STBC encoder symbols are converted in the time domain as given in Eq. (18).

$$s(t) = \frac{1}{\sqrt{N}} \sum_{k=0}^{N-1} X(k) e^{\frac{j2\pi nk}{N}} \tag{18}$$

where, $X(k)$=Input data in the frequency domain.

$$\mathrm{X(k)} = \begin{bmatrix} X_0 & -X_1^* \\ X_1 & X_1^* \end{bmatrix} \tag{19}$$

Finally, the equation of the Hybrid Space-Time – Hadamard Matrix (HST-HM) is derivation in the time domain of the MIMO – OFDM system in (20). The characteristics of the HST-HM are normalized spectral value of the input sequence, calculate the impulse response of the coefficients, very close to zero, implements 2n×2n matrix. Hardly, these are used in quantum computing of the system.

$$SH(n) = \sum_{f-1}^{f} s(t).h_f\ h_{xy} \tag{20}$$

where, s(t) $h_f h_{xy}$=Hybrid Space-Time – Hadamard Matrix (HST-HM).

The PAPR is the ratio of peak power to the average power of a signal, as given in Eq. (21).

$$PAPR\ (A(n)) = \frac{0 < n \le \frac{max}{LN-1}\ SH[n]^2}{E\ ([SH(n)]^2}) \tag{21}$$

where, $SH(n)$ is the proposed system of HST – HM technique for the reduction of PAPR

The main advantages of these HST-HM is appear (i) to involve only 1 and -1 in the matrix and also they are real numbers. (ii) The first row in the matrix are equal to one (iii) the frequency available in the signal will be increases the matrix until the final row of the input sequence.

Thus, the proposed HST-HM technique will be illustrated and formulated to develop the simulated result with the parameter based on the 5G communication.

4. METHODOLOGY

In this project proposal, there are two contributions methodologies involved to deliver and satisfy the 5G in wireless communication. The methodology used to propose are Omar Pigeon Space-Time (OPST) algorithm for RPR mobile in the Uplink and Hybrid Space-Time – Hadamard Matrix coding (HST-HM) Coding Techniques.

The block diagram of these two techniques is described in the state of the art of the proposed system section, how the RPR mobile app is used. The first methodology OPST is proposed to avoid Inter-Carrier Interference given below along with the flow chart in Figure 5 as follows.

Omar Pigeon Space-Time (OPST) algorithm in the Uplink

Step 1: Initialize the total number of subcarriers (SC), Constraints, and Iteration number (512, 1024) of data bits.
Step 2: Set the data set (Db) and subcarrier (SC) of space-time (st) search solution: Maxj to 512
Step 3: Define the maximum iteration of the center position from maxk to 1024.
Step 4: for each i € [1, Nsc] do
Step 5: Randomly set the appropriate space-time and distance of each subcarrier.
Step 6: end for
Step 7: Calculate the fitness (fd) data value of each subcarrier.
Step 8: If a new fitness data value is greater than the threshold time, recognize, replace.
Step 9: Place Db and SC conditions within the maximum threshold.
Step 10: While t ≤ maxj do
Step 11: Update the distance and space-time of each subcarrier using step1, 7 & 9.
Step 12: Messages displayed in RPR mobile (1)
Step 13: Update the transmitted SC and Db.
Step 14: End while
Step 15: Update space-time and distance between the SC.
Step 16: Message displayed in RPR mobile
Step 17: While Maxj<t<Maxj. Maxk do
Step 18: Use (3) and (6) to determine the threshold of SC, 1 to 1024.
Step 19: Update the number of SC (Nsc) by step 4.
Step 20: Refresh the space-time distance by step 5.
Step 21: Execute the fitness data value and finalize the space-time to transmit.
Step 22: end While

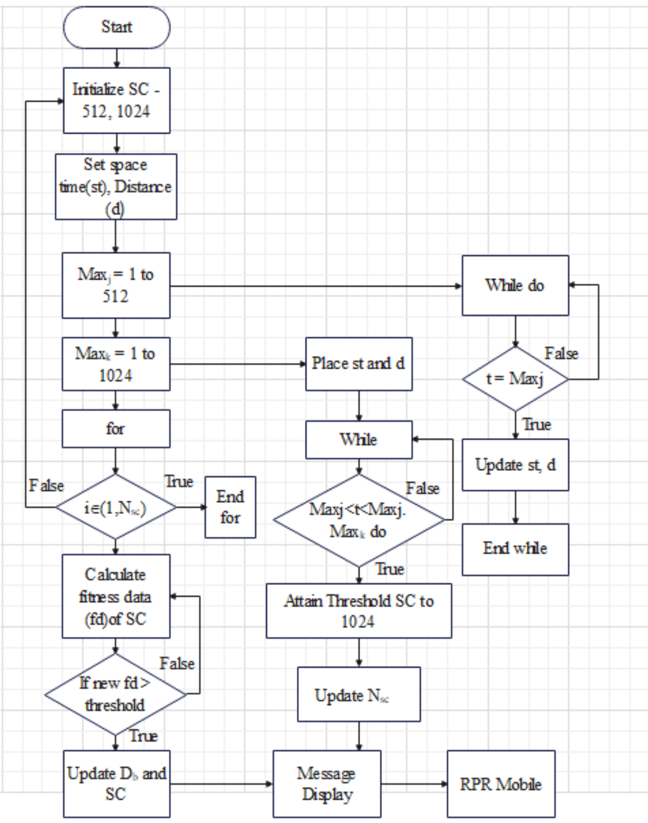

Figure 5. Flow chart of Omar pigeon space-time (OPST) algorithm

The second techniques (HST-HM) Coding Technique used to reduce the PAPR in the below steps and the flow chart is shown in Figure 6 to implement the experimental analysis in the MIMO – OFDM system.

Hybrid Space-Time – Hadamard Matrix coding (HST-HM) Coding Techniques:
Step 1: Set Input data stream within limit: X(k)
Step 2: Set Hadamard matrices: hf, hxy
Step 3: Initialize the space-time encoded data: S(k)
Step 4: Convert the frequency domain (fd) to time-domain (td) of OFDM input signal.
Step 5: Compute the STBC encoded symbols in the time domain samples of the OFDM signal: S(t)
Step 6: calculate HST – HM coding: SH(n)
Step 7: if HST-HM coding satisfies the condition, else go to Step 2
Step 8: Calculate PAPR (A(n))

$$PAPR\ (A(n)) = \frac{0 < n \leq \frac{max}{LN-1}\ SH[n]^2}{E\ ([SH(n)]^2}$$

Step 7: Update CCDF and PAPR0
Step 8: End

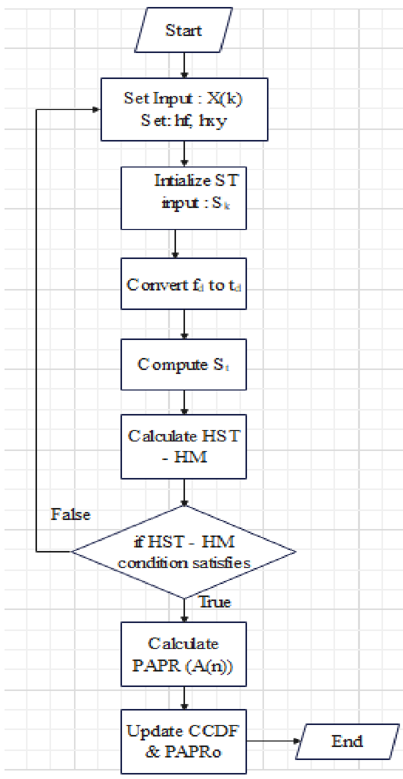

Figure 6. Flow chart of hybrid space-time – hadamard matrix coding (HST-HM) techniques

This work helps society to update all information of the real-time system, where the communication industry is working eminently. It improves the better transmission of input data bits with the given 5G high-speed data rate in wireless communication, and thus the state of the art of the proposed system is given in Figure 7.

The comparison of the HMT-HM (proposed) and STBC-EABC-PTS (existing) technique is given for the progressiveness in the below Table 1.

Table 1. Comparison of HMT-HM and STBC-EABC-PTS

S.N	Subcarriers	HST-HM (dB)			STBC-EABC-PTS (dB)		
		PAPR	BER	SNR	PAPR	BER	SNR
1	512	5.2	10^{-5}	14	4.3	10^{-3}	10
2	1024	9	10^{-7}	16	3.5	10^{-6}	12

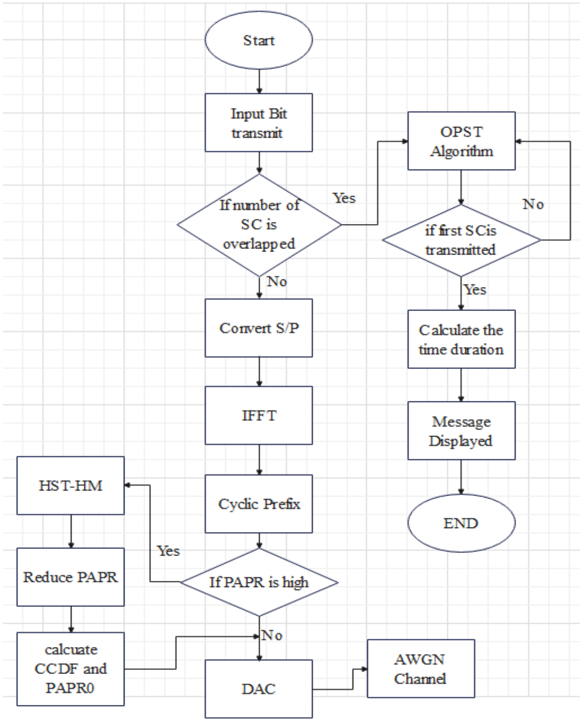

Figure 7. State of the art of the OPST and STBC -HT in MIMO- OFDM system

5. RESULTS AND DISCUSSION

The simulated results are analysed and with the experimental derivative for the proposed system as Hybrid Space-Time – Hadamard Matrix coding (HST-HM) Technique. By using this proposed system, the ICI and ISI are minimized accurately for each data symbol transmission with 5Gata rates for the mobile application. The simulated graph shows the interference, how it moves the data bit with the number of subcarriers one by one. Then, the interference will be calculated when each transmission very fast and efficiently as given in Figure 8 to Figure 14.

The parameters used for the proposed system are given in Table 2.

Hence, the interference is introduced if a number of subcarriers are transmitted with a bit symbols. The proposed system is used to reduce the ICI and ISI as given as an example for a simple simulated results in Figure 9.

In Figure 10, the proposed system is used to simulate the BER for the number of 512 subcarriers. The HST-HM technique executes with 10^{-5} dB as BER and the parameter SNR as 14 dB with the comparison of the existing system with STBC-EABC-PTS system.

Thus, the BER is reduced upto 10^{-7} dB for the 1024 number of subcarriers, whereas the SNR is obtained as 16dB for the HST-HM technique in Figure 11. Hence, the proposed system helps to reduce the error rate and to increase the SNR, which incorporate with the MIMO-OFDM system of the 5G application.

The PAPR values has been calculated and anlayzed by using the HST-HM technique, the simulated results have obtained 5.2 dB that are decreased compared to the existing systems. The STBC – EABC-PTS technique are higher than the proposed system as 6 dB, which is shown in Figure 12. This PAPR is yielded for the 12 number of subcarriers in the MIMO-OFDM system.

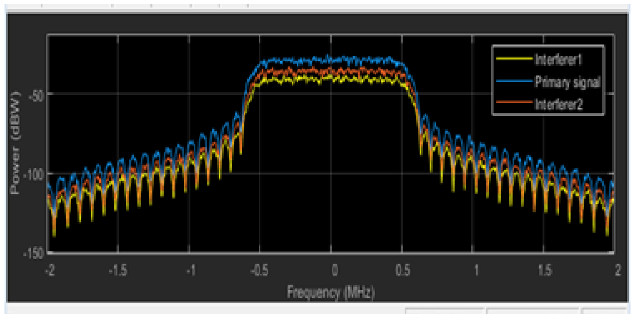

Figure 8. Results for the number of subcarriers to introduce interference

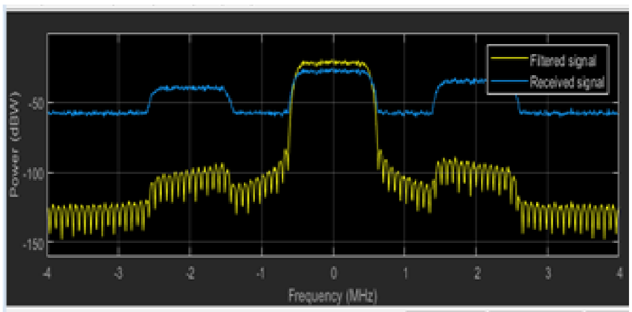

Figure 9. Results for the number of subcarriers to avoid interference

Table 2. Parameters

S.No	Parameter	Value
1	Number of data bits per OFDM symbol	10011101
2	System Sub-Carriers	512 &1024 (for each antenna (2×2))
3	Guard time	L = 8,16,32 & 64
4	Bandwidth (BW)	6 GHZ
5	PAPR Reduction technique	HST- HM
6	Users	U = 8, 16 & 32
7	Frequency	20 GHZ
8	5G Data rate	4Gbits
9	Delay	8-12 milliseconds

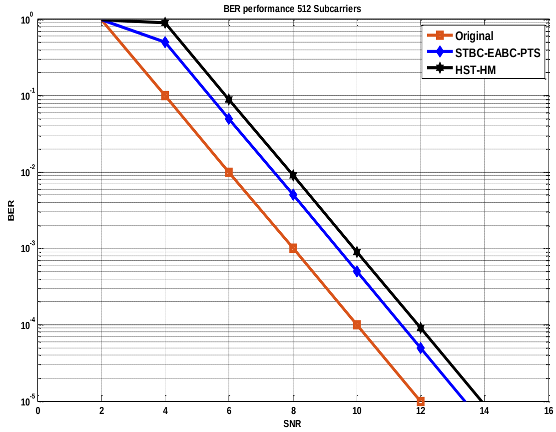

Figure 10. BER performance on 512 subcarriers using HST-HM

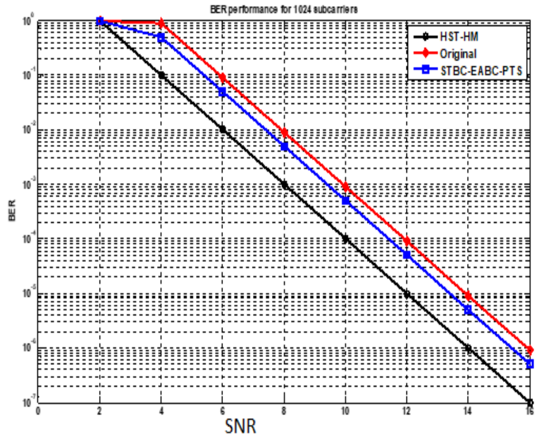

Figure 11. BER performance on 1024 subcarriers using HST-HM

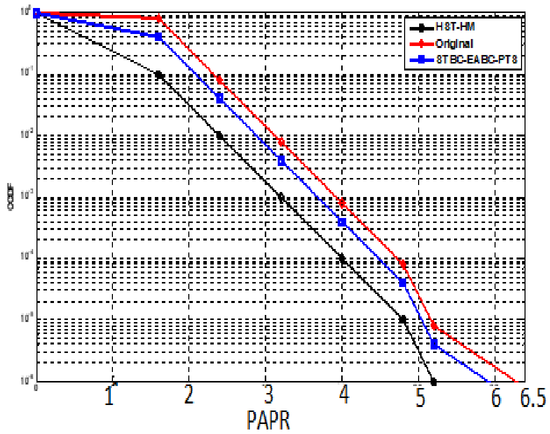

Figure 12. Simulated result of PAPR on 512 subcarriers using HST-HM

Code efficiency is performed with the proposed algorithm to increase the speed of the execution of the MATLAB software. The usage of the coding efficiency is to decease the source consumption and committed less completion duration. The MATLAB software depends on the quality of the efficiency of the communication coding.

In Figure 13, the PAPR value is simulated for 1024 subcarriers, which results as 9dB lesser than the existing system. The motive of the HST-HM is to find the time and amplitude by using the mobile application such as RPR mobile executes the outcomes through the OPST algorithm. It helps to simulate the values of increase with the increase until 0.6v amplitude in the y-axis and 0.3msec as time in the x-axis. Suddenly, the amplitude became constant from 0.3 msec time period as shown in Figure 14. Thus, the MATLAB software is used to simulate the outputs for different subcarriers of PAPR, BER, and SNR from Figure 8 to Figure 14.

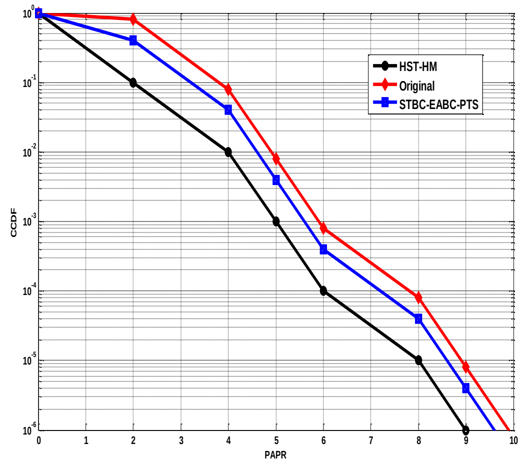

Figure 13. Simulated result of PAPR on 1024 subcarriers using HST-HM

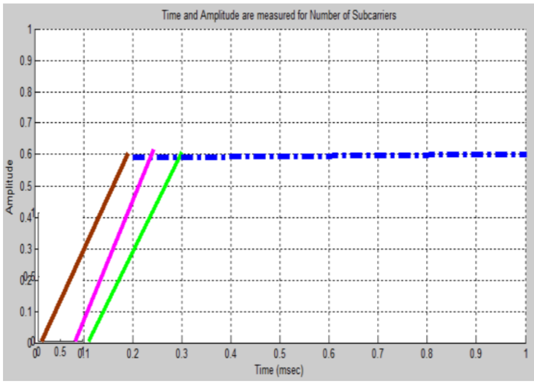

Figure 14. Time and amplitude calculation using HST-HM

6. CONCLUSIONS

Thus, the 5G works in many real-time applications with the MIMO -OFDM system for high data transmission. The main parameters available in these technologies are SNR and BER, illustrated to prove their measurements by using the proposed system. It helps to reduce the ICI and ISI and PAPR with required output without affecting the input data transmission. Hence, artificial intelligence plays a vital role for the 5G technologies in the MIMO – OFDM system. Thus, the Omar Pigeon Space-Time (OPST) algorithm with Hybrid Space-Time - Hadamard matrix technique is proposed to reduce the ICI and ISI within the period of transmission. The main problem is PAPR that is abruptly lesser up to 5.2 dB and 9dB to improve better performance of the system and provides the best efficiency. The RPR mobile is used to monitor the outcomes of the time and number of subcarriers during the transmission of the data bits parallelly. The BER is reduced to 10^{-5} dB for 512 and 10^{-7} dB for 1024 subcarriers in the proposed system of OPST with HST-HM technique.

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REFERENCES

[1] Akyildiz, I.F., Gutierrez-Estevez, D.M., Reyes, E.C. (2010). The evolution to 4G cellular systems: LTE-Advanced. Physical Communication, 3(4): 217-244. https://doi.org/10.1016/j.phycom.2010.08.001

[2] Kumutha, D., Amutha Prabha, N. (2017). Hybrid STBC-PTS with enhanced artificial bee colony algorithm for PAPR reduction in MIMO-OFDM system. Journal of Ambient Intelligence and Humanized Computing, 1-17. https://doi.org/10.1007/s12652-017-0595-0

[3] Tamilvizhi, T., Surendran, R., Krishnaraj, N. (2021). Cloud based smart vehicle tracking system. In 2021 International Conference on Computing, Electronics & Communications Engineering (iCCECE), pp. 1-6. https://doi.org/10.1109/iCCECE52344.2021.9534843.

[4] Surendran, R., Parvatha Varthini, B. (2013). Inject an elastic grid computing techniques to optimal resource management technique operations. Journal of Computer Science, 9(8): 1051-1060.

[5] Tamilvizhi, T., Surendran, R., Romero, C.A.T., Sendil, M.S. (2022). Privacy preserving reliable data transmission in cluster based vehicular adhoc networks. Intelligent Automation & Soft Computing, 34(2): 1265-1279. http://dx.doi.org/10.32604/iasc.2022.026331

[6] Baştürk, İ., Özbek, B. (2016). Iterative channel estimation for higher order modulated STBC-OFDM systems with reduced complexity. KSII Transactions on Internet and Information Systems. http://doi.org/10.3837/tiis.2016.06.001

[7] Al-Jawhar, Y.A., Ramli, K.N., Mustapha, A., Mostafa, S.A., Shah, N.S.M., Taher, M.A. (2019). Reducing PAPR with low complexity for 4G and 5G waveform designs. IEEE Access, 7: 97673-97688. https://doi.org/10.1109/ACCESS.2019.2930121

[8] Santumon, S.D., Sujatha, B.R. (2012). Space-time block coding (STBC) for wireless networks. International Journal of Distributed and Parallel Systems, 3(4): 183.

[9] Jha, S., Sultan, A., Alharbi, M., Alouffi, B., Sebastian, S. (2021). Secured and provisioned access authentication using subscribed user identity in federated clouds. International Journal of Advanced Computer Science and Applications, 12(11): 178-187.

[10] Ahmad, S., Jha, S., Alam, A., Alharbi, M., Nazeer, J. (2022). Analysis of intrusion detection approaches for network traffic anomalies with comparative analysis on botnets (2008–2020). Security and Communication Networks, 2022: 9199703. https://doi.org/10.1155/2022/9199703

[11] Gautam, P., Jatav, M.L. (2019). Performance analysis of 5G MIMO-OFDM systems in wireless communications using modified PTS scheme.

[12] Lee, M.H., Khan, M.H.A., Kim, K.J., Park, D. (2014). A fast hybrid Jacket–Hadamard matrix based diagonal block-wise transform. Signal Processing: Image Communication, 29(1): 49-65. https://doi.org/10.1016/j.image.2013.11.002

[13] Wang, Y., Chen, W., Tellambura, C. (2010). A PAPR reduction method based on artificial bee colony algorithm for OFDM signals. IEEE Transactions on Wireless Communications, 9(10): 2994-2999. https://doi.org/10.1109/TWC.2010.081610.100047

[14] Wang, H., Li, J. (2016). An intelligent receiver for space time block coded OFDM system. In 2016 First IEEE International Conference on Computer Communication and the Internet (ICCCI), pp. 535-538. https://doi.org/10.1109/CCI.2016.7778981

[15] Vittal, M.V.R., Naidu, K.R. (2017). A novel reduced complexity optimized PTS technique for PAPR reduction in wireless OFDM systems. Egyptian Informatics Journal, 18(2): 123-131. https://doi.org/10.1016/j.eij.2016.11.002

[16] Kumutha, D., Prabha, N.A. (2021). Design of multibaryonic H-shaped coupled microstrip antenna for Wi-Fi, WiMAX and 5G applications. In Advances in Automation, Signal Processing, Instrumentation, and Control, pp. 1341-1351. https://doi.org/10.1007/978-981-15-8221-9_125

[17] Riya, K.S., Surendran, R., Romero, C.A.T., Sendil, M.S. (2023). Encryption with user authentication model for internet of medical things environment. Intelligent Automation and Soft Computing, 35(1): 507-520.

[18] Kumutha, D., Prabha, N.A. (2018). Hilbert fast-SAMP with different channel estimation schemes of BER analysis in MIMO-OFDM system. International Journal of Internet Technology and Secured Transactions, 8(2): 221-237. https://doi.org/10.1504/IJITST.2018.093388

[19] Kumar, G., Gowri, S., Rajendran, S., Vimali, J.S., Jabez, J., Srininvasulu, S. (2021). Identification of cyber threats and parsing of data. In 2021 5th International Conference on Trends in Electronics and Informatics (ICOEI), pp. 556-564. https://doi.org/10.1109/ICOEI51242.2021.9452925

[20] Bhardwaj, L., Mishra, R.K. (2022). Downlink processing of massive MIMO-NOMA networks using cell sectored approach for 5G communication. Traitement du Signal, 39(1): 133-144. https://doi.org/10.18280/ts.390113

[21] Tamilvizhi, T., Surendran, R., Anbazhagan, K., Rajkumar, K. (2022). Quantum behaved particle swarm optimization-based deep transfer learning model for sugarcane leaf disease detection and classification. Mathematical Problems in Engineering, 2022: 3452413. https://doi.org/10.1155/2022/3452413

[22] Gowri, S., Surendran, R., Jabez, J., Srinivasulud, S. (2022). IoT forensics: What kind of personal data can be found on discarded, recycled, or re-sold IoT devices. Journal of Discrete Mathematical Sciences and Cryptography, 25(4): 999-1008. https://doi.org/10.1080/09720529.2022.2072422