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DC-biased Optical Systems for Reducing Peak-to-Average Power Ratio using Group Search Optimization Algorithm

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Abstract: In wireless communication system, the high peak to average power ratio (PAPR) leads to band distortion, out-of band radiation, computational complexity, Bit Error Rate (BER) and data rates. Many researchers have suggested more techniques about to minimize the PAPR in wireless communication. In this manuscript, DC-biased optical system is proposed to diminish PAPR with Group search optimization (GSO) algorithm. The major purpose of GSO is "lessen the computational complexity (CC) of PAPR method and search the optimum variation of phase factors. The proposed method is executed in MATLAB software. The proposed method is compared with various existing algorithms like tree growth optimization (TGO), fire work optimization (FWO) and whale optimization (WO) algorithms. Finally, the experimental outcomes show that the performance reduction in PAPR is 3.09% lower that existing methods, also Convergence curves of the GSO algorithms based PAPR is 3.62% lower than existing methods.

Keywords: *peak-to-average power ratio, group search optimization algorithm, computational complexity, convergence curve.*

1. INTRODUCTION

An enhancement of the information and communication technology is the advanced services of telephony, social networks and games of chance with Internet protocol [1]. The interior communication overcomes the Wi-Fi and mobile device denote the IP traffic is 55 percent [2, 3]. While the number of wireless features has augmented in recent years, they are demanding product integration. Existing radio frequency wireless media require higher bandwidth owing to their crowded and exclusive license spectrum [4]. In visible light communication (VLC) is deemed as the indoor transmission at high-speed owing to it's loose of bandwidth, maximum protection and localization ability [5, 6]. The sequence of orthogonal frequency division multiplexing (OFDM) including multiple level quadrature amplitude modulation (QAM) support with higher data rate diffusion diminishes the inter-symbol obstruction [7]. When controlling the optical signals for intensity variation with direct finding to require actual and optimistic gain of LED modulation [8]. Hermitian symmetry (HS) is utilized at inverse fast Fourier transform for obtaining the signal of actual value [9]. As per the subcarriers allocated in terms of bipolar and unipolar alterations on the existing optical OFDM system [10, 11]

In this manuscript, the GSO algorithm is more efficient for addressing the optimization issue. Here, a novel GSO algorithm [12] is introduced to overcome the high performance for reducing PAPR of direct current based optical OFDM with search complexity is low and more humble implementation. This method is more efficient to update the solution population, also determine the nearest optimum solution to the optimization issue. The proposed PAPR using group search optimization (PAPR-GSO) approach is intensely degrades the PAPR of direct current based optimal orthogonal frequency division multiplexing signals outperform the existing optimization with the help of solution quality as well as convergence rate.

The major contribution of this manuscript are mentioned as follows,

- In this manuscript, a new optimization method named group search optimization (GSO) is proposed for lessening the CC of PAPR system and search the optimum variation of phase factors.
- To enhance PAPR-GSO method, the consolidation of PAPR and group search optimization method is proposed.
- The PAPR-GSO is analyzed in various benchmarks
- The experimental outcomes demonstrate the performance of GSO-PAPR likened to the TGO, FO, and WO algorithm.
- General MATLAB simulations have been carried out to authorize the proposed method.

The remaining segment of this manuscript is designed as: Segment 2 delineates the literature review. Segment 3 describes the proposed system. Segment 4 demonstrates the result and discussion. Finally, Segment 5 concludes the manuscript.

2. LITERATURE REVIEW

Several research works are already existed in literature based on PAPR with various approaches. Certain works are reviewed here,

In 2019, Sharan et al [13] have presented the minimization of PAPR using the combination of VLC-OFDM Systems. Here, the OFDM was effectual modulation form for improving the ISI result. Orthogonal frequency division multiplexing in VLC system permits the maximal data rate transmission in competence exploiting the surrounding multipath that available in LED modulation bandwidth. Here, the combinative system that including pre-coding matrix and Mu-law combining model was presented to PAPR minimization. The simulation results show that the hybrid model was optimal explanation to attain the valuable tradeoff between the PAPR and enhance the bit error rate.

In 2018, Jiang et al [14] have suggested the direct current biased optical OFDM through pre-coding Matrix for Visible Light Communications. Here, examine the principle of PAPR minimization, clipping alteration optimization, equalization of signal to noise ratio. The simulation results show that the pre-coding matrix mode could optimize the BER efficiency on VLC-OFDM has sufficient transmission power. Thus the pre-coding matrix can damage by the BER performance in less transmitting power.

In 2019, Kishore et al [15] have presented the direct current polarized optical generalized frequency division multiplex of IM / DD methods. Here the unipolar physical layer waveform of IM / DD method named direct current polarized optical generalized frequency division multiplexing (DCO-GFDM) that depends on transmission based on block. The experimental results show that efficiency of BER was near to DCO-OFDM in lesser pulse shaping parameter and the result of PAPR with spectrum displays that decrease the noteworthy value was 1.5 dB at PAPR as well as 35 dB plummet on external band carrier power.

In 2019, Sharifi et al [16] have established the PAPR minimization of optical OFDM signals on visible light communications (VLC). Here, vandermonde such as matrix (VLM) pre-coding method was provided for lessening the maximal PAPR of direct current biased optical OFDM and irregular to VLC in signals. The established process was associated to Walsh–Hadamard transforms (WHT), discrete cosine transforms (DCT), discrete Hartley transform (DHT) models utilizing the reduction of PAPR efficiency. The simulation outcomes show that established process proficiently reduced the optical signal PAPR at DCO-OFDM models.

In 2018, Zhang et al [17] have introduced an improved linear non-symmetric transform (ILNST) to diminish the PAPR for VLC schemes based on asymmetric clipping optical OFDM. The emission power conservation criterion was calculated to increase co-efficient together with compression coefficient. The simulation results show that the bit error ratio, including the ILNST introduced complementary CCDF exceeds the standard non-symmetric linear transformation approach on minimizing PAPR with BER improvement.

In 2020, Ji et al [18] have presented the OFDM using intensity modulation / direct detection (IM / DD) that was a capable candidate for outlook passive optical network (PON). Here, the triple-layer hybrid optical OFDM method (THO-OFDM) for PON that integrates N-point asymmetrically clipped optical OFDM, whereas N / 2 point asymmetrically clipped optical OFDM signals for instantaneously broadcast. Compared with layered asymmetrically clipped optical OFDM (LACO-OFDM), the presented method deals with optimal spectral, energy proficiency, minimized PAPR and CC.

In 2017, Sheu et al [19] have suggested LED non-linearity mitigation strategy for optical VLC based on OFDM. The major purpose of suggested strategy was developing the mitigation technique for LED none linearizing the non-linear LED characteristics. The PAPR was to reduce the exploited for designing a transform pre-coding in the orthogonal cover code sequence. A simple pre-distorter was assumed in transmitter for linearizing the non-linearity of LED. Moreover, the researchers present a dynamic direct current biased model to obviate clipping noise on DCO-OFDM. Overall, suggested strategy in VLC transmitter could enhance the non-linearity of LED still for greater input signals

In 2019, Chow et al [20] have presented the performance of the VLC system. Here, a modified asymmetric chopped optical orthogonal frequency division multiplexing (MACO-OFDM) together with modified generalized light emitting diode index modulation OFDM (M-GLIM-OFDM) for achieving the similar bandwidth proficiency along conventional direct current polarized optical OFDM (DCO-OFDM) was presented. The simulation results show that expenditure of 3dB receptor sensitivity of M-ACO-OFDM presented with M-GLIMOFDM. While likened to traditional OFDM signal, there was an improvement of approximately 8 dB at PAPR minimization.

3. PROPOSED METHOD FOR DC-BIASED OPTICAL SYSTEM FOR MINIMIZING PAPR WITH GSO METHOD

In this section, DC-biased optical system for minimizing PAPR using Group search optimization method is discussed. For minimizing the PAPR at OFDM modulation depending on amplitude information that carriers the orthogonal transport phase in the low rate bit sequence using the modulation of binary phase shift key (BPSK) and QAM. When transmitted and receive signal is enabled to the parallel to serial conversions and serial to parallel conversions with the help of high data rate. The OFDM modulation combines the filters to simulate the discrete blocks. Through the signals are monitored by the modulation phase in each stage, in OFDM with the QAM mapping technique is shown in Figure 1. Here, an OFDM transmitter drives the Hermitian Symmetry (HS) is operated with the continuous light wave and generated from the distributed feedback with the optical power. The direct current biased optical system for lessening PAPR used in the orthogonal frequency division multiplexing. The optical signal experiences the implication process utilizing inverse fast Fourier transform in the emission of band pass filter in the realize of optical to electrical conversion. When the OFDM decodes the signal and transmitted DAC is encoded by the binary sequence. Inverse fast Fourier transform (IFFT) OFDM converts the QAM signals into the OFDM symbols and control the numbers in the subcarriers. The overall block diagram for the proposed method DC-biased optical systems for lessening PAPR is shown in Figure 1.

The orthogonal frequency division multiplexing scheme is group mapping that is made up of multi- sub carriers. Here, the M-ary QAM modulator in input binary stream is utilized to map the quadrature amplitude modulation symbols. In a visual communication system, the intensity of the optical system is converts to the electrical signal in LED. After that Hermitian symmetry operation is created the actual orthogonal frequency division multiplexing signals.

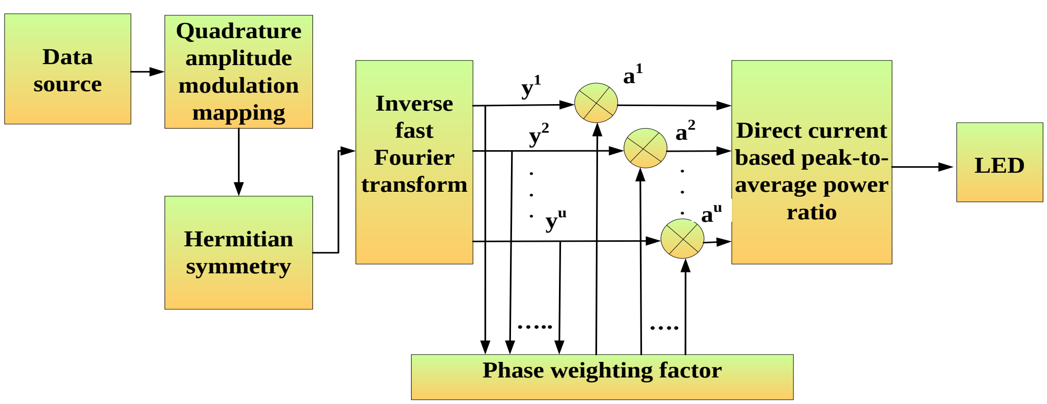

Figure 1: Block diagram for proposed DC-biased optical systems for minimizing PAPR

At Hermitian symmetry, DCO-OFDM is engaged for OFDM frequency domain $R=[R_1,R_2,.....,R_T]^K$ then the symbol of new frame is $Y^{GR}=[Y_1,Y_2,....,Y_M]^K$ attained like $M=2(T+1), Y_1=Y_{\frac{M}{2}+1}=0$ and $Y_T=Y^*_{M-T+2}=R_{T-1}$ for $2\le T\le T+1.$ The OFDM time domain is $Y=[Y_1,Y_2,....,Y_{M\ell}]^K$ that is calculated as given below,

$$y_m=\frac{1}{\sqrt{M\ell}}\sum_{t=1}^{M}Y_{t}^{e^{\frac{2\pi}{M\ell}t_n}}\ ; m=1,2,..M\ell \tag{1}$$

Where, ℓ is the oversampling factor, this is catch the OFDM signals in the maximum peaks signal. In the condition, $(\ell-1)M$ are amplified with the zeros in Y^{GR}. Cyclic prefix (CP) is involved in the direction of inter-carrier and inter-symbol interferences in each time domain to exclude the frame. The direct current biased is incorporated to the orthogonal frequency division multiplexing frame to create the +ve optical signal. The m th element of Y, Y_m is the sum of modulated subcarriers, then PAPR is attained. The number of subcarriers raises the PAPR. Then, P is determined in equation (2).

$$P = \frac{\max\{|y_m|^2\}}{F\{|y_n|^2\}}; m = 1,2,..M\ell \quad (2)$$

The average power is increased with the sub carriers and peak amplitude signals will decreased in PAPR diminution methods. The PAPR minimization is scaled by the curves of complementary cumulative distribution function (CCDF). When the CCDFs probability are taken into orthogonal frequency division multiplexing frame, which surpass the pre-defined threshold P_0 is expressed as below,

$$C = Q_s(P > P_0) = 1 - (1\exp(-P_0))^{M\ell} \quad (3)$$

In peak-to-average power ratio technique, an input data frame $R = [R_1, R_2, \ldots, R_T]^K$ is broken into U the sub block, formal as the vector $R_u = (u = 1,2,\ldots,U)$ is known as the fractional order. Such that $R = \sum_{u=1}^{U} R_u$ then the input data is simply partitioned, in which every sub carriers are utilized by another block in the sum of all disjoint sub blocks are initial data frames are equal. In PAPR are reduced by the mixed sub frames under the weight of partial sequence in the corresponding phase factor. At DC biased optical OFDM mode, the Hermitian symmetry has been worked for every sub-frame in R_u as well as novel sub frame attains Y_u^{GR}. The inverse fast Fourier transform sub frames are made by orthogonal frequency division multiplexing signal y is expressed as,

$$y = \sum_{u=1}^{U} a_u y_u = \sum_{u=1}^{U} a_u I\{Y_u^{GR}\} \quad (4)$$

The time factor $a_u \in \left\{ e^{\frac{2\pi}{w}v}; v = 0,1,\ldots,w-1 \right\}$ is developed for the partial sequence are weighting. Then the optimal phase factors are expressed as follows,

$$[a_1, a_2, \ldots, a_u] = \arg_{a_1, a_2, \ldots, a_u} \left\{ \max \left| \sum_{u=1}^{U} a_u y_u \right| \right\} \quad (5)$$

When the transmitted signal within PAPR is reduced,

$$\bar{y} = \sum_{u=1}^{U} a_u \bar{y}_u \quad (6)$$

The performance is increased with PAPR reduction within sub blocks count. In the optimal phase weighting factor, the first factor is set by $a_1 = 1$ and $U-1$ phases are chosen in the optimal solution. Thus, w^{U-1} is the combination of explored. The enormous amount of calculation is analyzed by the rotating phase sequence. To deal the search complexity, the factors of rotation phase have been limited for $\{=1,-1\}(w=2)$. Therefore, the huge value of 2^{U-1} is needed to the search and computational complexity is high.

3.1 Step by step procedure for DC-biased optical system for minimizing PAPR-GSO method

Here, the DC-biased optical system for minimizing PAPR-GSO is discussed. The GSO population is known as group, then every individual called member. GSO approach contains 3 styles of members (i) producers, (ii) scroungers (iii) rangers. During this producers execute the scanning mechanism within the way of producing strategy; scroungers execute the combining resources uncovered by the others in scrounging strategy, rangers executes the random walks to search the distributed resources. In each group the producer is treated because the best member and members except producer within the number of groupselected as the scroungers, as the rangers stared as the remaining members. By combining the Group search optimization algorithm (GSO) and PAPR scheme, Here, the PAPR-GSO method is proposed to seek out the nearest optimum phase factor and to minimize the CC in PAPR-GSO method for PAPR reduction issue. The DC-biased optical schemes for minimizing PAPR using GSO method consists of initialization, random generation, fitness function, producers, scroungers, rangers and validation. Step by step procedure for the DC-biased optical systems for minimizing PAPR using GSO is discussed below.

Step 1: Initialization

Initialize the initial population m using PAPR-GSO at m dimension search space and j th number of GSO in search iteration is l defined as the position vector $Y_j^l \in R^m$ and the head angle is $\varphi_j^l = (\varphi_{j1}^l, \ldots, \varphi_{j(m-1)}^l) \in R^{m-1}$. Here, R represents the set of real numbers in search direction is $C_j^l(\varphi_j^l)$ calculated according to φ_j^l is shown in equation (7)

$$C_j^l(\varphi_j^l) = (C_{j1}^l, \ldots, C_{jm}^l) \in R^m \quad (7)$$

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$$C_{ji}^{l} = \begin{cases} \prod_{p=1}^{m-1} \cos(\varphi_{jp}^{l}) & i = 1 \\ \sin(\varphi_{j(i-1)}^{l}) \prod_{p=1}^{m-1} \cos(\varphi_{jp}^{l}) & i = 2,\ldots,m-1 \\ \sin(\varphi_{j(m-1)}^{l}) & i = m \end{cases} \quad (8)$$

Step 2: Objective function

This is to diminish the total weighted operating times in order to primary relay to keep the operation of the coordinated backup relays. Then the objective function is described as follows,

$$F = \sum_{j=1}^{M} \omega_j T_j \quad (9)$$

Here, ω_j and T_j implies weight assigned by operation time of S_j for all relay ω_j is assigned by the objective function

Step 3: Fitness function

From the initialized values, the random number of solution is created. The fitness function can be evaluated with each solution as $E(Y_j^h)$. The fitness function of solution is assessed and the objective function is represented in an optimization of group search.

$$E(Y_j^h) = (e_1(Y_j^h),\ldots,e_q(Y_j^h),\ldots,e_M(Y_j^h)) \in R^M \quad (10)$$

Where, $E(Y_j^h)$ represents the fitness value of the objective function.

Step 4: Producer

Here, the producer testes three points and scans at zero degree are known as zero degree, then the hyper cubic points of right hand and let hand are calculated below, when the equation (11, 12 and 13) are used to searching the space.

$$Y_t = Y_q^l + s_1 k_{\max} C_q^l(\varphi^l) \quad (11)$$

$$Y_s = Y_q^l + s_1 k_{\max} C_q^l(\varphi^l + s_2 \theta_{\max}/2) \quad (12)$$

$$Y_k = Y_q^l + s_1 k_{\max} C_q^l(\varphi^l - s_2 \theta_{\max}/2) \quad (13)$$

Where, Y_q represents a producer position and $s \in R^1$ denotes random number that is always distributed with the mean value is 0 and 1 is the standard deviation and $s_2 \in R^{m-1}$ is uniformly distributed random variable in the (0, 1) interval. Moreover, $k_{\max}, \theta_{\max}$ are the maximum distance and maximum exploration angle.

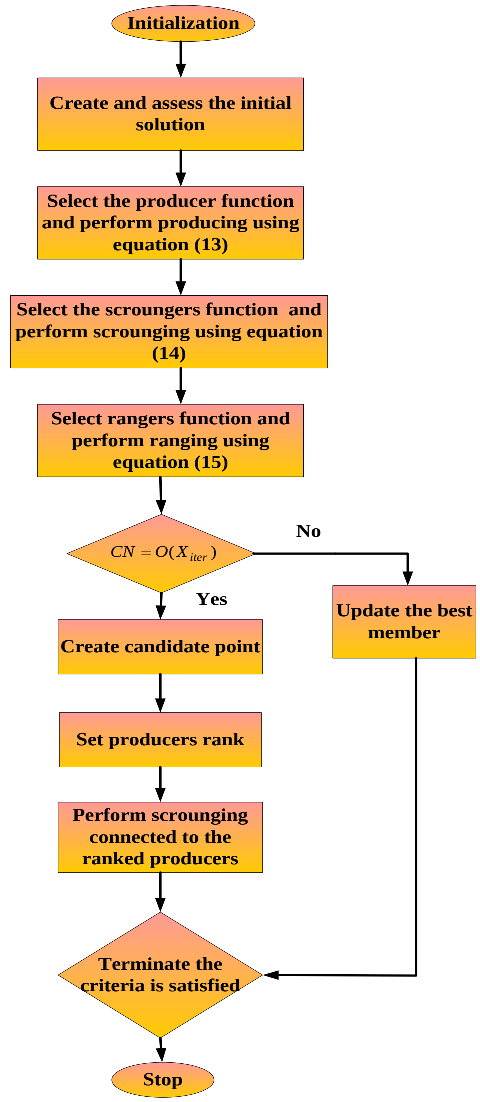

Figure 2: Flow chart for DC-biased optical systems for minimizing PAPR using Group search optimization algorithm

Step 5: Scroungers

After the producer stage, the best fitness value can determine by the producer point. The better value in the best point in current position comparison, then producer can perform that point and turn the current position according to the equation (14)

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$$\varphi^{l+1} = \varphi^{l} + s_2 b_{max} \quad (14)$$

Where, $b_{max} \in R^1$ represents maximal turning angle.

Step 6: Rangers
If the α sessions the producer does not determine the optimal arena, it can turn zero degree to its head back that is shown in equation (15)

$$\varphi^{l+b} = \varphi^{l} \quad (15)$$

Where, $\alpha \in R^1$ represents constant value.

Step 7: Decision making
Here, the candidate point's generation is discussed using generation rate. This step starts with decision making process and the decision making variables are calculated as follow equation (16)

$$CN = O(X_{iter}) \quad (16)$$

Where, CN represents the decision making, O explain the function variance, and X_{iter} represents the variable output. In CN, some iteration are not changed and their improvement is applied.

Step 8: Validation
In this step, the importance and throughput of Group search optimization technique are validated based on DC-biased optical systems for lessening PAPR. The DC biased optical system is the optical signal experiences the implication process using inverse fast Fourier transform at emission of band pass filter in the realize of optical to electrical conversion. Then, the performance of the PAPR-GSO is validated contradiction of existing algorithm like FWO, TGO, and WO algorithms.

4. RESULT AND DISCUSSION

This segment describes the simulation performance of proposed DC-biased optical systems for lessening peak-to-average power ratio depending on Group search optimization algorithm (PAPR-GSO). The simulation is executed in MATLAB R 2015 software. In this manuscript, the PAPR reduction of DC biased optical based OFDM signals is deemed. A proposed group search optimization algorithm, simulate the optical phase factor in the solution phase. The efficiency of the proposed DC-biased optical systems for lessening PAPR-GSO is analyzed and compared to tree growth optimization (TGO) [21], fire work optimization (FWO) [22] and whale optimization (WO) [23] algorithms. Table 1 tabulates the simulation parameter of the proposed method.

Table 1: Simulation parameters

Parameter	Value
FFT size	64
Modulation	16-QAM
Phase factor	$w = (0, 2\pi)$
Software	MATLAB
Oversampling factor	ℓ

4.1 Performance comparison of various methods

Figure 3 to 8 portrays the simulation outcome for lessening the PAPR system. In this segment, the various performance are calculated such as PAPR reduction with PAPR-GSO, comparison of complementary cumulative distribution function amid the proposed and existing optimization methods, peak-to-average power ratio performance along different sub-block for QAM/OFDM scheme based GSO, PAPR depending on convergence curves of GSO, FWO, TGO and MO methods, comparison of convergence rate of PAPR reduction andCCDF comparison of PAPR in 16-QAM are discussed. Here, the performance of the proposed DC-biased optical systems for lessening the PAPR with Group search optimization algorithm was analyzed and compared to tree growth optimization (TGO), fire work optimization (FWO) and whale optimization (WO) algorithms.

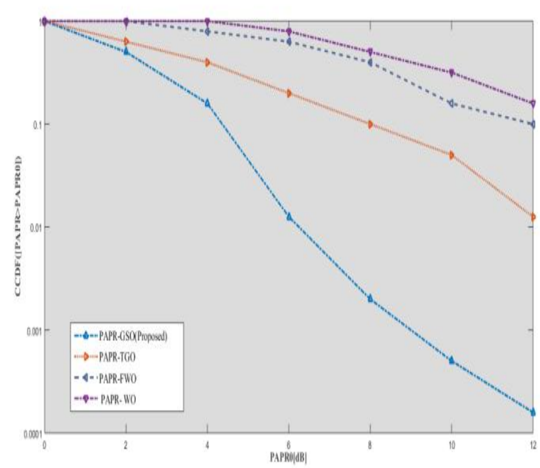

Figure 3: PAPR reduction with PAPR-GSO

Figure 3 shows the PAPR reduction with PAPR-GSPO algorithm. Here, the proposed method peak-to-average power ratio using Group search optimization algorithm (PAPR-GSO) produce 3.09% lower than existing tree growth optimization (TGO), 4.17% lower than fire work optimization (FWO) and 11.48% lower than whale optimization (WO) algorithms in 2 dB. The proposed

PAPR-GSO produce 6.18% lower than existing PAPR-TGO, 6.66% lower than PAPTR-FWO and 10.78% lower than PAPR-WO in 4 dB respectively. The proposed PAPR-GSO produce 7.12% lower than existing PAPR-TGO, 6.52% lower than PAPTR-FWO and 7.78% lower than PAPR-WO in 6 dB respectively. The proposed PAPR-GSO produce 5.26% lower than existing PAPR-TGO, 5.46% lower than PAPTR-FWO and 6.34% lower than PAPR-WO in 8 dB respectively. The proposed PAPR-GSO produce 3.15% lower than existing PAPR-TGO, 8.19% lower than PAPTR-FWO and 5.69% lower than PAPR-WO in 10 dB respectively. The proposed PAPR-GSO produce 7.41% lower than existing PAPR-TGO, 9.12% lower than PAPTR-FWO and 6.38% lower than PAPR-WO in 12 dB respectively.

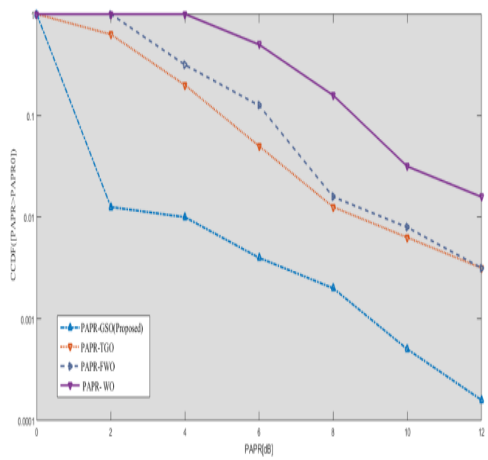

Figure 4: CCDFs comparison amid the proposed and existing optimization methods

Figure 4 shows the complementary cumulative distribution functions comparison amid the proposed and existing optimization methods. Here, the proposed PAPR-GSO produce 8.04% lower than existing tree growth optimization (TGO), 9.19% lower than fire work optimization (FWO) and 13.25% lower than whale optimization (WO) algorithms in 2 Db, The proposed PAPR-GSO produce 9.19% lower than existing PAPR-TGO, 8.98% lower than PAPTR-FWO and 10.22% lower than PAPR-WO in 4 dB respectively. The proposed PAPR-GSO produce 7.77% lower than existing PAPR-TGO, 4.25% lower than PAPTR-FWO and 6.52% lower than PAPR-WO in 6 dB respectively.The proposed PAPR-GSO produce 5.84% lower than existing PAPR-TGO, 6.39% lower than PAPTR-FWO and 6.07% lower than PAPR-WO in 8 dB respectively. The proposed PAPR-GSO produce 6.55% lower than existing PAPR-TGO, 5.25% lower than PAPTR-FWO and 5.36% lower than PAPR-WO in 10 dB respectively. The proposed PAPR-GSO produce 4.72% lower than existing PAPR-TGO, 4.86% lower than PAPTR-FWO and 4.70% lower than PAPR-WO in 12 dB respectively.

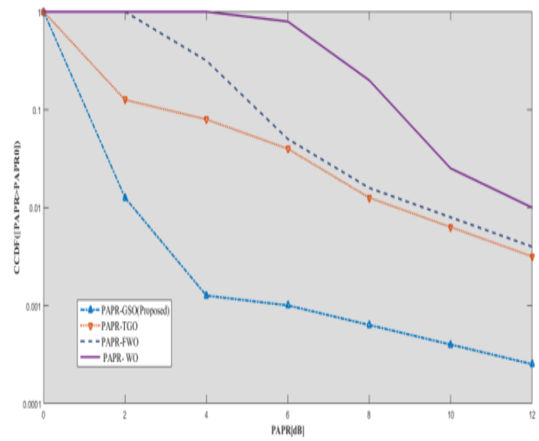

Figure 5: PAPR performance with different sub-block for GSO depending on OFDM scheme

Figure 5 shows the peak-to-average power ratio performance with different sub-block for GSO depending on orthogonal frequency division multiplexing scheme. Here, the proposed PAPR-GSO produce 5.26% lower than existing tree growth optimization (TGO), 6.06% lower than fire work optimization (FWO) and 6.57% lower than whale optimization (WO) algorithms in 2 dB The proposed PAPR-GSO produce 6.12% lower than existing PAPR-TGO, 6.66% lower than PAPTR-FWO and 6.77% lower than PAPR-WO in 4 dB respectively. The proposed PAPR-GSO produce 6.87% lower than existing PAPR-TGO, 7.01% lower than PAPTR-FWO and 7.18% lower than PAPR-WO in 6 dB respectively.The proposed PAPR-GSO produce 8.96% lower than existing PAPR-TGO, 9.03% lower than PAPTR-FWO and 6.43% lower than PAPR-WO in 8 dB respectively. The proposed PAPR-GSO produce 5.58% lower than existing PAPR-TGO, 1.97% lower than PAPTR-FWO and 7.07% lower than PAPR-WO in 10 dB respectively. The proposed PAPR-GSO produce 3.62% lower than existing PAPR-TGO, 3.94% lower than PAPTR-FWO and 3.13% lower than PAPR-WO in 12 dB respectively.

Figure 6 shows the convergence curves of GSO, FWO, TGO, MO methods based PAPR. Here, the proposed PAPR-GSO produce 3.62% lower than existing tree growth optimization (TGO), 3.94% lower than fire work optimization (FWO) and 3.13% lower than whale optimization (WO) algorithms in iteration 500. The proposed PAPR-GSO produce 4.15% lower than existing PAPR-TGO, 5.33% lower than PAPTR-FWO and 9.62% lower than PAPR-WO in iteration 1000 respectively. The proposed PAPR-GSO produce 4.92% lower than existing PAPR-TGO, 10.58% lower than PAPTR-FWO and 2.32% lower than PAPR-WO in iteration 1500 respectively. The proposed PAPR-GSO produce 3.23% lower than existing

PAPR-TGO, 2.27% lower than PAPTR-FWO and 2.81% lower than PAPR-WO in iteration 2000 respectively. The proposed PAPR-GSO produce 14.63% lower than existing PAPR-TGO, 17.5% lower than PAPTR-FWO and 15.47% lower than PAPR-WO in iteration 2500 respectively. The proposed PAPR-GSO produce 18.29% lower than existing PAPR-TGO, 10.12% lower than PAPTR-FWO and 12.64% lower than PAPR-WO in iteration 3000 respectively.

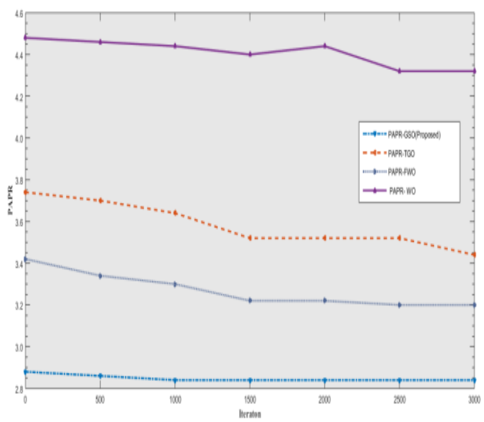

Figure 6: Convergence curves of GSO, FWO, TGO, MO methods based PAPR

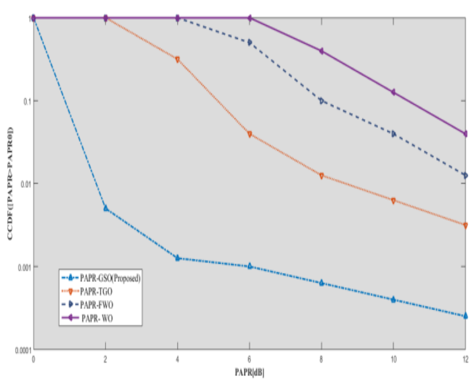

Figure 7: Comparison of convergence rate of PAPR reduction

Figure 7 displays the comparison of PAPR minimization convergence rate. Here, the proposed method PAPR with Group search optimization algorithm (PAPR-GSO) produce 17.94% lower than existing tree growth optimization (TGO), 15.74% lower than fire work optimization (FWO) and 22.72% lower than whale optimization (WO) algorithms in 2 dB. The proposed PAPR-GSO produce 47.27% lower than existing PAPR-TGO, 33.33% lower than PAPTR-FWO and 22.58% lower than PAPR-WO in 4 dB respectively. The proposed PAPR-GSO produce 40.32% lower than existing PAPR-TGO, 24.28% lower than PAPTR-FWO and 22.05% lower than PAPR-WO in 6 dB respectively.The proposed PAPR-GSO produce 18.57% lower than existing PAPR-TGO, 30.55% lower than PAPTR-FWO and 59.32% lower than PAPR-WO in 8 dB respectively. The proposed PAPR-GSO produce 33.33% lower than existing PAPR-TGO, 43.39% lower than PAPTR-FWO and 23.94% lower than PAPR-WO in 10 dB respectively. The proposed PAPR-GSO produce 49.18% lower than existing PAPR-TGO, 54.23% lower than PAPTR-FWO and 61.53% lower than PAPR-WO in 12 dB respectively.

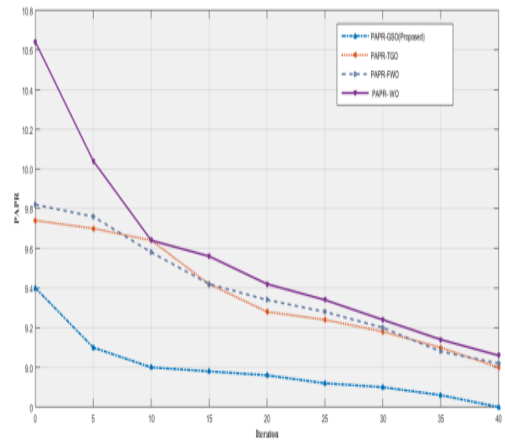

Figure 8: CCDF comparison of PAPR in 16-QAM

Figure 8 depicts that CCDF comparison of PAPR in 16-QAM. Here, the proposed method PAPR with Group search optimization algorithm (PAPR-GSO) produce 36.66% lower than existing tree growth optimization (TGO), 46.47% lower than fire work optimization (FWO) and 38.25% lower than whale optimization (WO) algorithms in iteration 5, The proposed PAPR-GSO produce 29.85% lower than existing PAPR-TGO, 60.29% lower than PAPTR-FWO and 55.24% lower than PAPR-WO in iteration 10 respectively. The proposed PAPR-GSO produce 31.03% lower than existing PAPR-TGO, 28.57% lower than PAPTR-FWO and 16.66% lower than PAPR-WO in iteration 15 respectively.The proposed PAPR-GSO produce 21.05% lower than existing PAPR-TGO, 29.41% lower than PAPTR-FWO and 24.85% lower than PAPR-WO in iteration 20 respectively. The proposed PAPR-GSO produce 22.22% lower than existing PAPR-TGO, 36.34% lower than PAPTR-FWO and 128..57% lower than PAPR-WO in iteration 25 respectively. The proposed PAPR-GSO produce 33.33% lower than existing PAPR-TGO, 42.85% lower than PAPTR-FWO and 42.53% lower than PAPR-WO in iteration 30 respectively.

5. CONCLUSION

In this manuscript, DC-biased optical systems for lessening PAPR using GSO algorithm is proposed. Here, the GSO algorithm is used to find the nearest optical solution phase.

The proposed method is executed in MATLAB site. The efficiency of the PAPR-GSO technique can be established over finding the PAPR reduction with PAPR-GSO, CCDFs comparison amid the PAPR-GSO method and other optimization methods, the performance of peak-to-average power ratio with different sub-block for QAM/OFDM method based GSO, Convergence curves of GSO, FWO, TGO and MO methods based PAPR, comparison of convergence rate of PAPR reduction and CCDF comparison of PAPR in 16-QAM. Finally, the experimental outcomes demonstrate that proposed PAPR-GSO is lower to existing methods such as PAPR-TGO, PAPR-FWO, and PAPR-WO. The PAPR reduction with PAPR-GSO method produces 92% better than existing methods.

REFERENCES

[1] T. Wang, Y. Ren, C. Li and Y. Hou, **A PAPR reduction scheme combining superimposed O-OFDM and μ-law mapping for VLC-OFDM systems**, *Optics Communications*, vol. 460, p. 125190, 2020. Available: 10.1016/j.optcom.2019.125190.

[2] F. Ebrahimi, Z. Ghassemlooy and S. Olyaee, **Investigation of a hybrid OFDM-PWM/PPM visible light communications system**, *Optics Communications*, vol. 429, pp. 65-71, 2018. Available: 10.1016/j.optcom.2018.08.001.

[3] L. Hao and C. Li, **A Stacked Autoencoder Method for the PAPR Reduction in VLC Systems,** *2020 Asia-Pacific Conference on Image Processing, Electronics and Computers (IPEC)*, 2020. Available: 10.1109/ipec49694.2020.9115123.

[4] J. Ren, T. Wang, C. Wang and D. Li, **Low-PAPR Superimposed Layered ACO-OFDM for VLC Systems**, *2020 12th International Conference on Communication Software and Networks (ICCSN)*, 2020. Available: 10.1109/iccsn49894.2020.9139094

[5] A. Sharifi and H. Emami, **PAPR reduction of asymmetrically clipped optical OFDM signals: Optimizing PTS technique using improved flower pollination algorithm,** *Optics Communications*, vol. 474, p. 126057, 2020. Available: 10.1016/j.optcom.2020.126057.

[6] T. Zhang, S. Qiao, F. Zhong and S. Guo, **Gaussian Matrix based PAPR Reduction Scheme for DCO-OFDM Systems**, *Optik*, vol. 145, pp. 513-518, 2017. Available: 10.1016/j.ijleo.2017.07.067.

[7] A. Abdulkafi, M. Alias and Y. Hussein, **A Novel Approach for PAPR Reduction in OFDM-Based Visible Light Communications**, *2017 International Conference on Platform Technology and Service (PlatCon)*, 2017. Available: 10.1109/platcon.2017.7883678 [Accessed 22 February 2021].

[8] O. Saied, Z. Ghassemlooy, S. Rajbhandari and A. Burton**, Optical single carrier-interleaved frequency division multiplexing for visible light communication systems,** *Optik*, vol. 194, p. 162910, 2019. Available: 10.1016/j.ijleo.2019.06.010.

[9] G. Miriyala and V. Mani, **A new PAPR reduction technique in DCO-OFDM for visible light communication systems**, *Optics Communications*, vol. 474, p. 126064, 2020. Available: 10.1016/j.optcom.2020.126064.

[10] Y. Li, H. Qiu, X. Chen and J. Fu, **A novel PAPR reduction algorithm for DCO-OFDM/OQAM system in underwater VLC**, *Optics Communications*, vol. 463, p. 125449, 2020. Available: 10.1016/j.optcom.2020.125449.

[11] L. Deng, Y. Fan and Q. Zhao**, A novel PAPR reduction scheme for VLC DCO-OFDM systems,** *Optics Communications*, vol. 426, pp. 164-169, 2018. Available: 10.1016/j.optcom.2018.05.055.

[12] H. Teimourzadeh and B. Mohammadi-Ivatloo**, A three-dimensional group search optimization approach for simultaneous planning of distributed generation units and distribution network reconfiguration,** *Applied Soft Computing*, vol. 88, p. 106012, 2020. Available: 10.1016/j.asoc.2019.106012.

[13] N. Sharan, S. Ghorai and A. Kumar**, Peak-to-Average Power Ratio (PAPR) Reduction Using Combination of Precoding and Companding Techniques for VLC OFDM Systems,** *2019 TEQIP III Sponsored International Conference on Microwave Integrated Circuits, Photonics and Wireless Networks (IMICPW)*, 2019. Available: 10.1109/imicpw.2019.8933194 [Accessed 22 February 2021].

[14] T. Jiang et al., **Investigation of DC-Biased Optical OFDM With Precoding Matrix for Visible Light Communications: Theory, Simulations, and Experiments,** *IEEE Photonics Journal*, vol. 10, no. 5, pp. 1-16, 2018. Available: 10.1109/jphot.2018.2866952.

[15] V. Kishore and V. Mani, **A DC Biased Optical Generalised Frequency Division Multiplexing for IM/DD systems**, *Physical Communication*, vol. 33, pp. 115-122, 2019. Available: 10.1016/j.phycom.2018.12.014.

[16] A. Sharifi, **PAPR reduction of optical OFDM signals in visible light communications**, *ICT Express*, vol. 5,

no. 3, pp. 202-205, 2019. Available: 10.1016/j.icte.2019.01.001.

[17] T. Zhang, Y. Zou, J. Sun and S. Qiao**, Improved Companding Transform for PAPR Reduction in ACO-OFDM-Based VLC Systems**, *IEEE Communications Letters*, vol. 22, no. 6, pp. 1180-1183, 2018. Available: 10.1109/lcomm.2018.2827940.

[18] H. Ji, B. Lin, X. Tang and J. Xu, **Triple-layer hybrid optical OFDM scheme for passive optical network,** *Optics Communications*, vol. 466, p. 125622, 2020. Available: 10.1016/j.optcom.2020.125622.

[19] J. Sheu, B. Li and J. Lain, **LED non- linearity mitigation techniques for optical OFDM- based visible light communications**, *IET Optoelectronics*, vol. 11, no. 6, pp. 259-264, 2017. Available: 10.1049/iet-opt.2017.0059.

[20] Assaidah and C. Chow, **Performances of M-ACO-OFDM, DCO-OFDM and M-GLIM OFDM in Visible Light Communication Systems**, *2019 25th Asia-Pacific Conference on Communications (APCC)*, 2019. Available: 10.1109/apcc47188.2019.9026516 [Accessed 22 February 2021].

[21] H. Emami and A. Sharifi, **A novel bio-inspired optimization algorithm for solving peak-to-average power ratio problem in DC-biased optical systems**, *Optical Fiber Technology*, vol. 60, p. 102383, 2020. Available: 10.1016/j.yofte.2020.102383.

[22] A. Lahcen, A. kamal, H. Mustapha, E. Ali, A. Saida and A. Adel, **Peak-to-Average Power Ratio Reduction Using New Swarm Intelligence Algorithm in OFDM Systems**, *Procedia Manufacturing*, vol. 32, pp. 831-839, 2019. Available: 10.1016/j.promfg.2019.02.291.

[23] M. Sarkar, A. Kumar and B. Maji, **Security aware hybrid precoding based peak-to-average power ratio reduction Approaches for telecommunication systems,** *International Journal of Communication Systems*, vol. 33, no. 14, p. e4531, 2020. Available: 10.1002/dac.4531.