Power Allocation in MIMO OFDM system using ANN-PSO

G.Koteswar Rao, G. Laxminarayana

***Abstract:** Multiple-Input-Multiple-Output (MIMO) system has several antennas at both the transmitter and receiver, it is a frequency selective for multipath characteristics. In this , we present different MIMO detection algorithms and compares with proposed Particle Swarm Optimization (PSO) algorithm to estimates BER. This will be minimized by providing the PA scheme at transmitter end and the SINR. Orthogonal Frequency Division Multiplexing (OFDM) is used to get high data rates in wireless communication. Combination of MIMO-OFDM system used for converting the frequency selective channels into a parallel collection of frequency flat sub channels. Due to the environment some noises such as Additive-White-Gaussian-Noise (AWGN) are added in the MIMO-OFDM. This leads to degrades the performance of the MIMO-OFDM system in terms of the Bit Error Rate (BER). MIMO-OFDM system uses Space Time Block Coding (STBC) scheme is used for enhancing the reliability of the system. Here, the power optimized mainly depends on the Particle Swarm Optimization (PSO) based Neural Network (NN) for. PSO optimizes the power by the channel noise and channel distance, it is produced the output in the form of power. After that, the NN provides the optimum power to the MIMO OFDM antennas by considering the optimized power value from the PSO with its respective noise value. The performance of the proposed method is analyzed in terms of bit error rate.*

***Keywords:** MIMO, OFDM, STBC, PSO,ANN, Power allocation, BER, Signal to noise ratio.*

I. INTRODUCTION

Now a day, wireless communication becomes a trend in many ways such as mobile online games, high quality online video calling and mobile multimedia transmissions, etc. So, the requirements of radio spectrum also increase, which makes radio spectrum more and more expensive. MIMO technology increases spectral efficiency and reliability by using multiple antennas at the transmitter and receiver sides. The MIMO systems has been improves the system's performance [1], [2]. The V-BLAST architectures are proposed in [3] and [4], also named as Bell layered space time - ordered successive interference cancellation (B-OSIC) detector is used in MIMO systems for an attractive solutions that exploits this potential. In a B-OSIC receiving end, thedetector first selects the received data stream with strongest signal-to-interference-noise ratio (SINR)and after that it subtracts from the received signal, and this process is successively performed for the remaining all data streams.

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To allocate the power at transmitting antennas array, it is optimized with feedback using different optimization techniques. The power allocation process at transmitters using beam-forming is also analyzed in detail [6] and system closed form expressions are derived for Quality of Service (QoS), allocating power at transmitters to increase the throughput for wireless networks[7]. In MIMO systemsPower efficiency maximization in multicellular cooperation networks for provisioning diverse QoS is also explored [8]. Co-operative relaying techniques has become a major topic in the wireless research community again [9], [10]. Optimization problems is the main limitation of the Co-operative relaying techniques [11]. The power allocation of MIMO with imperfect channel state information for interference channels has been analyzed in [12]. The major issue of stability and queuing delay for heavy traffic is addressed in detail in [13]. While considering the queuing system and scheduling system of users, the important properties like average waiting time and access time with emphasis on channel dynamics areaddressed in detail in [14].

These all properties are very important in scheduling in wireless networks. In MIMO systems, for scheduling with a many number of users withservice requirements of different classes is also analyzed in [15] and also in MIMO sysyems for an analytical framework of scheduling with imperfect CSI has explained in [16, 17]. All the existing algorithms have some limitations like more BER, noisy output, etc. To overcome these limitations, particle swarm optimization and Artificial Neural Network based Power Allocation in MIMO-OFDM system is introduced in this paper. This method is used for improving the parameters such as SINR and BER.

II. SYSTEM MODEL

The "PSO-ANN-PA-MIMO-OFDM" system is used mainly for power allocation to the antennas present in the system. This PSO-ANN-PA-MIMO-OFDM system consists of nine major steps such as1). Data generation, 2). OFDM Modulation,3).MIMO transmission using STBC Encoding 4).PSO optimization, 5). Neural network power allocation,6).MIMO STBC decoding receiver,7). OFDM demodulation, 8).Noise &Distancemeasurement and 9).Performance measurement. The Block diagram is shown in the Figure.

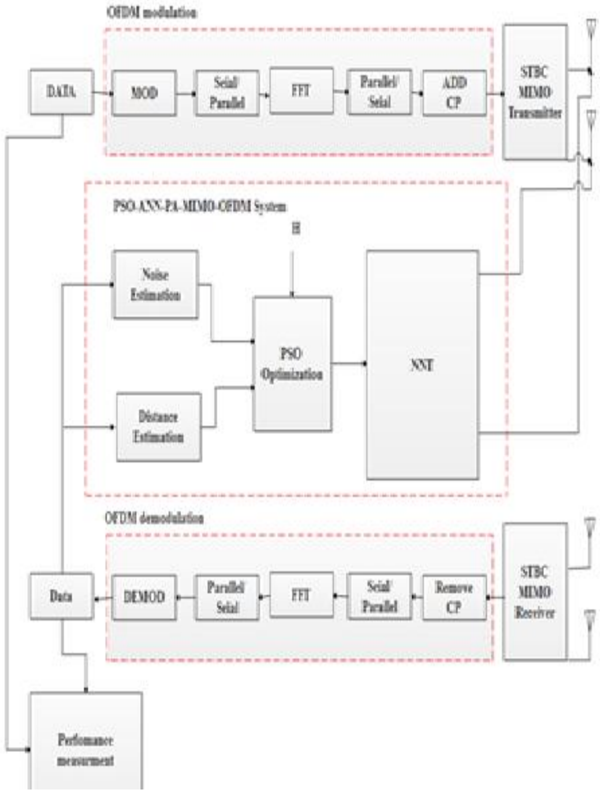

Figure. 1. PSO-ANN-PA-MIMO-OFDM" system

III. MIMO LINEAR DETECTION Schemes

A.Zero-Forcing Detector (ZF)

At receiver, linear detection system is used to receive signal vector x is multiplied with the filter matrix G andafter followed by a parallel decision on all remaining layers. Zero-forcing means that the mutual interference between the different layers in channel shall be perfectly suppressed.

$G_{ZF} = H^{+} = (H^H H)^{-1} H^H$ (1)

whereH is full column rank. The filter output vector is

$\tilde{s}_{ZF} = G_{ZF}\,\mathrm{y} = H^{+}\mathrm{y} = \mathrm{s} + (H^H H)^{-1} H^H \mathrm{n}$ (2)

An error covariance matrix given below, in that the main diagonal elements represents an estimation errors of the differentlayers.

$\emptyset_{ZF} = \mathrm{E}\{(\tilde{s}_{ZF} - \mathrm{s})(\tilde{s}_{ZF} - \mathrm{s})^H\} = \sigma_n^2 (H^H H)^{-1}$ (3)

In this detector noise is amplified and it tends to infinity. In order to increase the performance, to reduce noise we go for MMSE detection scheme.

B. MMSE Detector

The Minimum MSE detector minimizes the error in between the actual transmitted symbols and theoutput of the linear detector represented by the filter matrix

$G_{MMSE} = \left(H^H H + \sigma_n^2 I_{N_t}\right)^{-1} H^H$ (4)

In MMSE detector , resulting filter output is given as

$\tilde{s}_{MMSE} = G_{MMSE}\,\mathrm{y} = \left(H^H H + \sigma_n^2 I_{N_t}\right)^{-1} H^H\,\mathrm{y}$ (5)

An estimated error in different layers corresponding to the main diagonal elements of the error covariance matrix is

$\emptyset_{MMSE} = \mathrm{E}\{(\tilde{s}_{MMSE} - \mathrm{s})(\tilde{s}_{MMSE} - \mathrm{s})^H\}$

$= \sigma_n^2 (H^H H + \sigma_n^2 I_{N_t})^{-1}$ (6)With the definition of a an $(N_r + N_t)$ X N_t augmented channel matrix $\bar{H}$, an $(N_r + N_t)$ X 1 extended receive vector $\bar{y}$ and an N_t X 1 zero matrix $0_{N_t,1}$ can be written as

$\bar{H} = \begin{bmatrix} H \\ \sigma_n I_{N_t} \end{bmatrix} \rightarrow Ordering\ \ \bar{Q}\bar{R}and\bar{y} = \begin{bmatrix} y \\ 0_{N_t,1} \end{bmatrix}$.

an output of the MMSE detector is given by

$\tilde{s}_{MMSE} = (\bar{H}^H \bar{H})^{-1} \bar{H}^H \bar{y} = \bar{H}^{+} \bar{y}$ (7)

And the error covariance matrix becomes as shown in below,

$\emptyset_{MMSE} = \sigma_n^2 (\bar{H}^H \bar{H})^{-1} = \sigma_n^2 \bar{H}^{+} \bar{H}^{+H}$ (8)

C. MMSE-QR-Detection scheme

To extending the QR based detection scheme , Introducing the QR decomposition with the extended channel matrix is

$\bar{H} = \begin{bmatrix} H \\ \sigma_n I_{N_t} \end{bmatrix} = \bar{Q}\bar{R} = \begin{bmatrix} Q_1 \\ Q_2 \end{bmatrix} \bar{R} = \begin{bmatrix} Q_1 \bar{R} \\ Q_2 \bar{R} \end{bmatrix}$(9)

where the $(N_r + N_t)$ X N_t matrix $\bar{Q}$with orthogonal columns was partitioned into the an N_r X $N_t$matrix Q_1 and the N_t X N_t matrix Q2. Obviously,

$\bar{Q}^H \bar{H} = Q_1^H + \sigma_n^2 Q_2^H = \bar{R}$(10)

holds and from the relation $\sigma_n I_{N_t} = Q_2 \bar{R}$it follows that

$\bar{R}^{-1} = \frac{1}{\sigma_n} Q_2$ (11)

Using (10) and (11), the filtered receive vector becomes

$\tilde{s} = \bar{Q}^H \bar{y} = Q_1^H \mathrm{y} = \bar{R}\,s - \sigma_n Q_2^H\,\mathrm{s} + Q_1^H$ (12)

The diagonal elements of the error covariance matrix is

$\emptyset = \sigma_n^2 (\bar{H}^H \bar{H})^{-1} = \sigma_n^2 \bar{R}^{-1} \bar{R}^{-H}$ (13)

The system estimation error after perfect interference cancellation is given by $\sigma_n^2 / |\bar{r}_{k,k}|^2$.

D.Description of the BER Performance

Power Allocation scheme for BPSK modulation can be expressed as

minimize$\frac{\mathbf{1}}{\boldsymbol{N_t}} \sum_{\boldsymbol{k=1}}^{\boldsymbol{N_t}} \boldsymbol{Q}(\sqrt{\mathbf{2}}\,\boldsymbol{\gamma_s P_k \bar{R}_{k,k}}) \approx \frac{\mathbf{1}}{\boldsymbol{N_t}} \sum_{\boldsymbol{k=1}}^{\boldsymbol{N_t}} \boldsymbol{Q}(\sqrt{\mathbf{2}\boldsymbol{\rho_k}})$

.l

s.t $\sum_{\boldsymbol{k=1}}^{\boldsymbol{N_t}} \boldsymbol{P_k^2} = 1$, $0 < \boldsymbol{P_k} < 1$,

$\boldsymbol{\bar{R}_{k,k}} \geq \mathbf{0}$, $\in \{\mathbf{1}, \mathbf{2}, \ldots \ldots, \boldsymbol{N_t}\}$ (14)

where Q(x) = $\sqrt{\mathbf{1/2\pi}} \int_x^{\infty} \boldsymbol{e}^{-(\frac{t^2}{2})}\,\boldsymbol{dt}$ and $\boldsymbol{\gamma_s} = \sqrt{\frac{E_s}{\sigma_n^2}}$.

We assume $\boldsymbol{\bar{R}_{k,k}} \geq \mathbf{0}$ because it is defined as the normal of the $\boldsymbol{k_{th}}$ column of the channel matrix [8].

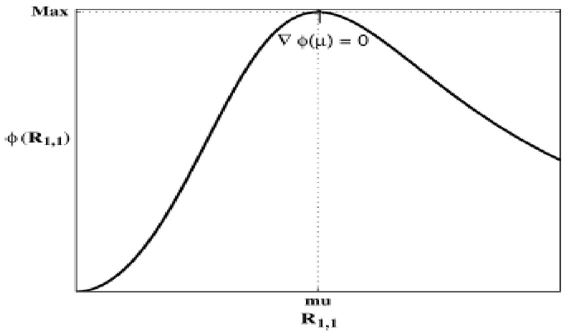

Figure. 2. Graph of $\emptyset(\overline{\boldsymbol{R}}_{1,1})$.

IV PROPOSED PSO-ANN-PA-MIMO-OFDM SYSTEM

OFDM is a multicarrier modulation that produces the various sub streams by separating the transmitted bit stream. These sub streams are transmitted over a various sub channels. Generally, the sub channels which are present in this system is should be orthogonal and also the intersymbol interference (ISI) of this OFDM is low. For providing the very high-reliability and high-data rate system, the combination of MIMO-OFDM is introduced.

Consider MIMO-OFDM system has A_t transmitting antennas and A_r receiving antennas, it is represented as $A_t \times A_r$. In MIMO-OFDM-STBC system model, the ith transmit and jth receive antennas are modelled in a wide sense stationary, uncorrelated scattering as well as the M number of paths are enabled in the Rayleigh fading channel in the complex equivalent low-pass-time-variant impulse response is given in equation (15).

$$h^{(i,j)} = \sum_{m=0}^{M-1} \gamma_m^{(i,j)} \alpha(\tau - \tau_m^{(i,j)}) (15)$$

Where, the mth path gain from the ith transmit antenna to the jth receive antenna, and also propagation delay for mth path from ith antenna to the jth receive antenna is denoted as$\tau_m^{(i,j)}$.

The fades among the various transmitting and receiving antennas are considered as independent and identically distributed for provide the simplicity. The transmitted symbols in the OFDM system are$U^{(i)}$, $R^{(j)}$ through the ith antenna and these samples are received demodulated by the receiver antenna$j$.

The symbol which is transmitted through the ith antenna is given as the following equation (16).

$$u_a^{(i)} = \frac{1}{\sqrt{A}} \sum_l^{A-1} U_l^{(i)} exp\left(j \frac{2\pi a l}{A}\right) 0 \le a \le A - 1$$
(16)

Where the transmitted data sequence from the ith transmit antenna is represented as $\left\{U_l^{(i)}\right\}_{l=0}^{A-1}$, $1 \le i \le A_t$.

The MIMO-OFDM frame structure is shown in the Figure 3, the frame has one preamble. In MIMO-OFDM system, the synchronization is made by the preamble as well as it is used for the channel estimating as the orthogonal structure.

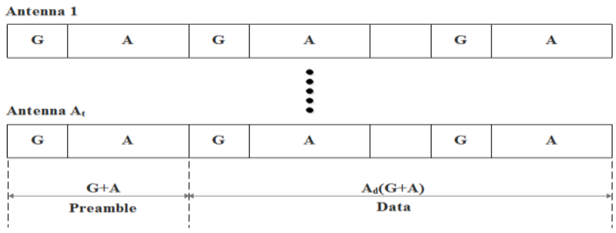

Figure 3. Frame structure of MIMO-OFDM

The following equation (17) describes the sample sequence of the receiver antenna j after neglecting the guard interval.

$$r_o^{(j)} = \sum_{i=1}^{A_t} \sum_m^{M-1} \gamma_m^{(i,j)} u_{(o-\tau_m^{(i,j)} O)}^{(i)} + w_o^{(j)} (17)$$

Where, the complex AWGN samples with variance A_0 at the receiving antenna is denoted as $w_o^{(j)}$, the residual of integer l module A. The result is in the interval [0, A-1].

FFT is used for demodulating the received signal and it is given in the following equation (18).

$$R_l^{(j)} = FFT\{r^{(j)}\}(l)$$

$$= \sum_{i=1}^{A_t} H_l^{(i,j)} U_l^{(i)} + W_l^{(j)} (18)$$

A. Space Time Block Coding

After performing the modulation process, the data packets are send to the STBC encoder and STBC decoder for encoding and decoding the data packets respectively. Assume in STBC there are A_t amount of transmitting antennas and A_r amount of receiving antennas. The codes which is used in the STBC is orthogonal and it obtains the full transmit diversity that is described by the amount of transmit antennas. STBC is a much more complex version of the Alamouti's space time code. In that following equation (19), the rows of the following matrix represents the different time instant and the columns of the following matrix denotes the transmitted symbol along with each different antenna.

$$\begin{bmatrix} s_{11} & s_{12} & \cdots & s_{1nT} \\ s_{21} & s_{22} & \cdots & s_{2nT} \\ \vdots & \vdots & \ddots & \vdots \\ s_{T1} & s_{T1} & \cdots & s_{TnT} \end{bmatrix} (19)$$

STBC encoder is used for mapping from the modulated symbols to a transmission matrix. The encoder input symbols are separated into several symbols groups. The symbols which is employed in the group is based on the amount of transmit antennas and a mapping rule. A transmission matrix is $P \times M$, where $P$is the time slots and $M$is the transmit antennas. Through the different antennas the different symbol columns are delivered and also in different time slots different symbol rows are transmitted. STBC decoding is achieved by the maximum likelihood and linearity processing at the receivers.

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An input symbol of STBC encoder is divided into 2 groups. Each group data such as $\{D_1, D_2\}$ is delivered simultaneously in a given period T. The data which is transmitted by the STBC encoder is mapped by the constellation mapper and the constellation samples are shown in equation (20).

$$[D_1 D_2] \rightarrow \begin{bmatrix} D_1 & -D_2^{\,*} \\ D_2 & D_1^{\,*} \end{bmatrix} \quad (20)$$

The block diagram for the STBC encoder is given in following.

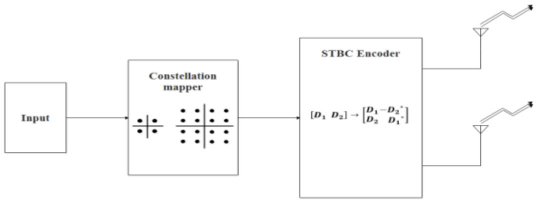

Figure4 .STBC encoder

Based on the Alamouti code, the STBC is implemented with two antennas and it is shown in the following Figure 5. This STBC achieves the full gain. The data such as D_1 and D_2 which is transmitted simultaneously through the antennas. This transmission is performed at any given time slot T. At the time of $T+t$, the information D_1^* is delivered through the antenna number 2 and the information $-D_2^*$ is transmitted along with the antenna number 1. The receiving operation is accomplished by using two timeslots, at first timeslot the R_1 is gathered similarly R_2 is received in second timeslot. The noise such as N_1 and N_2 is added in receivers R_1 and R_2. The noise that is added in the receiver is shown in the following equation (21) and (22).

$$R_1 = h_1 D_1 + h_2 D_2 + N_1 \quad (21)$$

$$R_2 = -h_1 D_2^* + h_2 D_1^* + N_2 \quad (22)$$

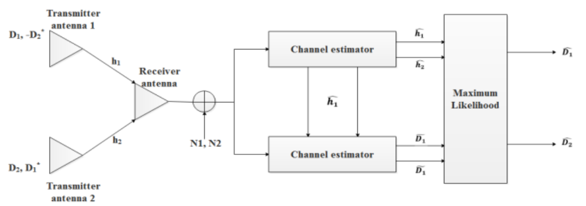

Figure 5. Structure of Alamouti's STBC

Where, the channel fading factor based on the Rayleigh distribution is denoted in terms of h_1 and h_2.

The following equation (23) and (24) concludes the diversity gain for two inputs which is delivered by the transmitter.

$$\tilde{D}_1 = h_1^* R_1 + h_2 R_2^* = (|h_1|^2 + |h_2|^2) D_1 + h_1^* N_1 + h_2 N_2 \quad (23)$$

$$\tilde{D}_2 = h_2^* R_1 + h_1 R_2^* = (|h_1|^2 + |h_2|^2) D_2 + h_2^* N_1 + h_1 N_2 \quad (24)$$

STBC introduced with two number of antennas, it has the 2-orders diversity gain. Full rate is minimized and the code rate is equal. There is no loss of frequency during the data transmission.

Therefore the received signal of system is expressed in the following equation (25),

$$R = hD + N \quad (25)$$

Where, the sending vector is represented as S and the received vector is denoted as R.

B. Power allocation based on the NNT with PSO optimization

In "PSO-ANN-PA-MIMO-OFDM" system, power allocation is made by the PSO based NN. At first, the PSO algorithm is used to optimize the power values with the help of encoded data, decoded data and distance between the transmitting and receiving antennas. Then the optimized power values are given to the input to the NN. The NN plays a key role in the power allocation, it selects the optimum power value from the data base.

C. Particle Swarm Optimization

In PSO, there are three different values are provided as input such as encoded data, decoded data and distance between the transmitting and receiving antennas. By correlating the encoded and decoded data from the MIMO-OFDM, the noise occurred in the transmitted signal is determined. The optimum power value from the PSO is selected by considering two different values such as distance and noise value. In general, PSO is a computational optimization algorithm is introduced in 1950 by Kennedy and Eberhart. Due to the complexity in Particle Swarm Optimization algorithm, it can simplify many times. Search is motivated by the social behavior of organisms. Particularly, the choreography of bird's flock led to the design of PSO. This algorithm is initialized with a swarm of different solutions in a multiple dimensional space. Each solution,it"s also known as a particle, has the

Define the size of the channel noise and channel distance, number of iterations iter_n
For i=1 to iter_n
    For j=1 to size of particle set (50 sets)
        For k= 1 to N
        Apply each set to the pixel
        Find the fitness value of the function
            If (current fitness <pre_fitness)
                Move for next random pixel value generation
            Else
            Go to the next particle set
            End
        End
End
Obtain the best fitness value such as optimized power by applying the corresponding channel distance, channel noise and channel matrix.
End

ability to move. Therefore, particle $\boldsymbol{i}$ has two parameters **x** specifies location and **v** specifies speed of the particle.During the change in movement, every particle updating their position and velocityaccording to its own experience.$\boldsymbol{i}$ is in interactive communication with the neighbor particles in order to finding best position. In that best position of particle is called***pbest***and best so far position in total swarm is called ***gbest.***

The fitness function used in the PSO-ANN-PA-MIMO-OFDM methodology considered two different values such as channel noise and distance. By considering these values in the PSO, the optimum

power is obtained in each iteration. Because, if the MIMO-OFDM antennas does not have enough power to transmit the data bits, the data loss will occur in the respective transmission system. Simply, assumes that a $\boldsymbol{D}$-dimensional search space the $\boldsymbol{I^{th}}$particle is represented by $\boldsymbol{xi} = (\boldsymbol{xi1}, \boldsymbol{xi2}, \dots . \boldsymbol{xiD})$ and $\boldsymbol{vi} = (\boldsymbol{vi1}, \boldsymbol{vi2}, \dots . \boldsymbol{viD})$ as $\boldsymbol{D}$ -dimensional arrays for the positions and velocities. $\boldsymbol{x}$and$\boldsymbol{v}$are updated using these two equations (26) and (27).

$$\boldsymbol{V_{id}^{k+1} = wxV_{id}^{k} + C_1 r_1 (pbestd - x_d^k) + C_2 r_2 (gbestd - xdk} \quad (26)$$

$$\boldsymbol{X_{id}^{k+1} = X_{id}^{k} + V_{id}^{k+1}} \quad (27)$$

Where $\boldsymbol{d = 1, 2, \dots\dots, D, i = 1, 2, \dots\dots, N}$,

are the sizes of dimension and swarm, $\boldsymbol{C_1}$ and $\boldsymbol{C_2}$ are +ve constants, $\boldsymbol{r_1}$ and $\boldsymbol{r_2}$ are random numbers and these are uniformly distributed in the interval of[0,1], where$k = 1,2, \dots .,$ denotes the iteration number, Typically, PSO starts with a larger w, and decreasing gradually over the iterations. The following equation (28) is adopted for $w$to simulate its descending property.

$$w = (w_{initial} - w_{final}) X \frac{(k_{max} - k)}{k_{max}} + w_{final} \quad (28)$$

Here $w_{initial}$ is the preliminary value of w, w_{final} is the final value of w, k is the iteration number, and $w = k_{max}$ is the maximum number of iterations.

Pso Algorithm:

D.Neural network

A type of artificial intelligence is that attempts to imitating the way of a human brain works. Rather thanusing a digital models, in which all computations manipulate onesand zeros, a neural network is working by creating connections in between processing elements, the computer equivalent of neurons. The Neural network consist of two major steps such as testing and training, which are explained as follows.

NN basically contains a nonlinear functional blocks named as neurons which is connected to each other based on the parallel synaptic weights as well as each neuron have some corresponding threshold value. To create the activation of a neuron, the weighted sum of inputs is formed and the threshold is subtracted. There also hidden neurons presented inside the network, these neurons play an internal role in the network. In that training, there are two different inputs are given to the neuron the channel noise and power. The noise and power values are measured for varying data values from 10 bits to 1Kbits at 0dB of SNR. Initially, the distance between the transmitter and to the receiver has considered as a constant, it should be varied when the SNR is varied along with the BER. Channel distance is the distance from the transmitter to the receiver and channel noise is the amount of noise (AWGN) generated during the transmission as well as the power from the PSO. Based on the noise and power values from the MIMO-OFDM, the NN is trained and it creates database. The weights of the neurons are adjusted while performing the training operation. The neural network training window is shown in the Figure.6.In NN testing, the optimized power value is selected based on the power value from the PSO and noise value. By considering these values in the PSO-ANN-PA-MIMO-OFDMsystem, the power from the PSO is optimized related to that noise value. The power allocation for each antenna design is made for different MIMO-OFDM system designs in various SNR values. Power allocation for each antenna is estimated based on the noise and power. Because, the received signal has some noise while transmitting, it leads to increase the BER. Power value should be high, when the distance from the transmitter to the receiver is high.

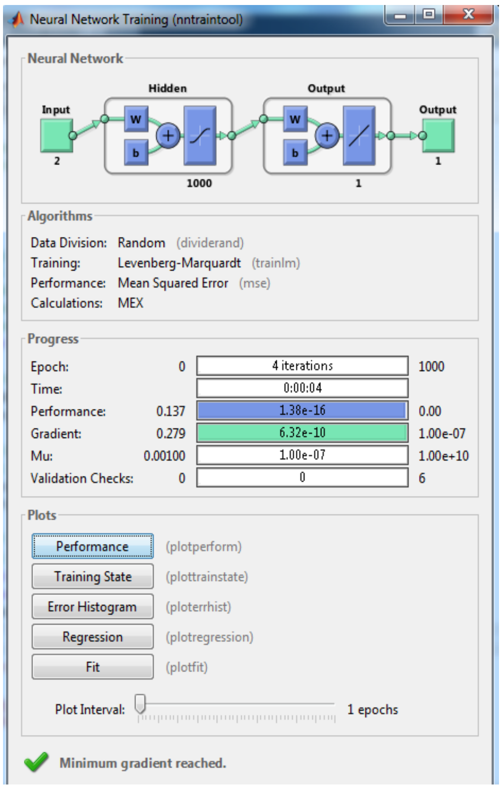

Figure 6.Neural Network training window.

V. SIMULATION RESULTS

PSO-ANN-PA-MIMO-OFDMsystemhas implemented by using MATLAB 2017b software tool with communication and Neural Network tool box (for the simulation purpose) through the i5 desktop computing environment with 8 GB RAM memory capacity. In this PSO-ANN-PA-MIMO-OFDMsystemhas consist of two section such as, training and testing. Training is the major important part of the system, by using table.1 parameters Neural Network training is done.

Table 1. Neural network training parameters

PSO-ANN-PA-MIMO-OFDMsystemNeural Network training	
Data bits	100 random bits data's (with pocket size of 64)
Sampling rate	2e6
Path delays	0 to 2e-6
Neural Network inputs	2
Neural Network outputs	1
Hidden layers	1000

PSO-ANN-PA-MIMO-OFDM system's NN is tested based on the parameters of Table 2. There are 100 random bits are produced (with the sampling rate 2e6 and block size of 64) in the second part of the PSO-ANN-PA-MIMO-OFDM testing. After generating the random bits, these bits going to the modulation process under QPSK. The output of the modulator in the form of 50×1 and the cyclic prefix is added in the next step. The data's are generated for the cyclic prefix in the floor (0.5*length (modData)) and it generates the data according to the 75×1 form. Finally, IFFT and cyclic prefix is performed for protecting the OFDM signal from the Inter Symbol Interference (ISI). IFFT produces the output in the form of 75×1 complex double format.

PSO-ANN-PA-MIMO-OFDMsystemTesting	
Data bits	1000 bits data's (with pocket size of 64)
Sampling rate	1e6
Path delays	0 to 2e-6
Modulation & demodulation	QPSK
Channel encoding & decoding	STBC
Channel type	AWGN + Rayleigh fading
Antenna type	2×2, 4×2, and 4×4
SNR value for analysis	-10 :3:10

able 2. Neural network testing parameters

STBC encoder is used for transmitting the data and it encodes the before performing data transmission. The antenna designs which is used in the transmission such as 2×2, 4×2 and 4×4. AWGN and Rayleigh noise are added in the transmitting signal by propagating the signal through the AWGN and Rayleigh fading environment. The noise are added based on the SNR value (-10 to 10). The receiving section such as 2×2, 4×2 and 4×4 antennas receives the signal and the received signal is affected by noise and the STBC decoder decodes the received signal, after that the FFT process and cyclic prefix eliminating process and QPSK modulation is applied to the receiver signal and the output data is received. From that received signal, the amount of noise and distance between the transmitter and receiver should be estimated. These data's are used with channel matrix in PSO optimization process, it produces the optimized power and it is allocated for each transmitting antenna. Finally, the performance of PSO-ANN-PA-MIMO-OFDM system is analyzed with the existing system .

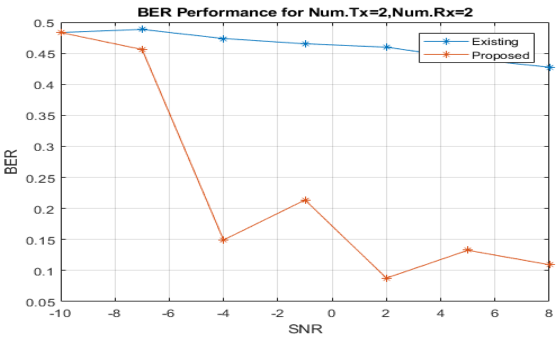

Figure 7. Bit error rate analysis for 2×2 PSO-ANN

Figure 7 and 8 Shows the comparison about the BER for 2×2 and 4 x 4 PSO-ANN-PA-MIMO-OFDM system. From the graph, conclude that the BER is decreased by increasing the SNR as well as it has greater performance compared to the existing method .

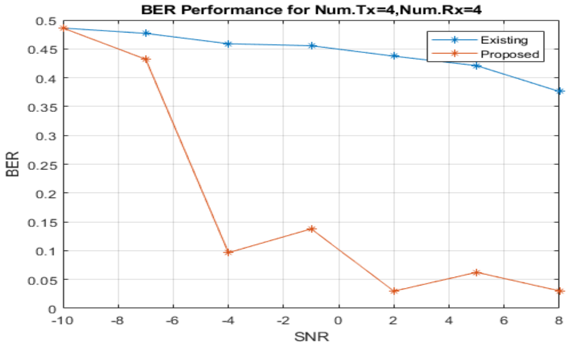

Figure 8. Bit error rate analysis for 4×4 PSO-ANN

VI. CONCLUSION

The PSO-ANN-PA-MIMO-OFDM system enables with MIMO-OFDM system with STBC along with PSO and NN used for optimizing the MIMO-OFDM system. STBC is used for enhancing the reliability by transmitting a multiple copies of an information signal across a several antennas and it combines the received signal. Distance among the transmitter and receiver and the noise is estimated, it is used for optimizing the power by PSO. The Training of NN is mainly based on the power from the PSO and its respective channel noise. The neural network gives the exact power for each antenna and it is assigned to the respective transmitting antennas. Power allocation for each antenna makes the system with more reliability. PSO-ANN-PA-MIMO-OFDM system improves the performance by increasing the SNR and decreasing the BER.

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