Soft Computing Techniques for Channel Equalization

Ami Kumar Parida, Subodh Panda, R. P. Singh

Abstract: ***Communication of Information at present days needs higher data rate through the channels. The rate of information on these channels is finite in the main by inter symbol Interference (ISI). The basic techniques as Channel equalizers are generally adapted to minimize consequences of Inter-Symbol Interference. During this paper, a replacement equalizer based on soft computing is conferred. The outcome on the planned equalizer is deeply considered for every channel having its own bit-error rate with noisy data. The simulation result shows the better performance of equalized in terms of bit error rate as compared to earlier equalizer on least mean square or multilayer perception techniques.***

Index Terms: Bit Error Rate (BER), Channel equalizer, Hybrid learning algorithmic program, Inter symbol interference (ISI), Membership function and optimal Bayesian equalizer.

I. INTRODUCTION

A. Back Ground of the Model:

Soft computing could be a syndicate of basic principle of design that works very systematically and gives data for further processing of information for most complex problems also**..** This determined flexibility and quality of systems measuring and lots of standard l models in order to give suitable outputs. Usually, soft computing techniques tally human brain cell character a lot of similarity than ancient system of operation.. These are supported on logical operated systems, like behavioral logic and operational logic. The associative parts of Soft computing process are meant to eliminate limitation with adding some useful scope to one another. Artificial Neural network (NN), fuzzy inference system (FIS), Evolutionary computation (EC) [2].

Intelligent search, swarm Technology, Bayesian network and modern signal process concept and practice are most useful elements of soft computing. Most of all computing methodology consists of high potential and other more different benefits measure statistic, sturdy to uncertain and have an error free on extremely non-linear characteristic of system define. Fuzzy inference system supported with a natural network structure to address noisy and data beyond range helps for the analysis of media in the fashion of multi-resolution.

B. Equalization Using Neural Network:

Sufficient advances are created in generating intelligent systems, impressed by biological character based neuron activities , Out come from several scientific research activities are planning through all possible soft computing activities such as pattern recognition, function approximation, prediction, optimization, associative memory, and control.

General available approaches are planned for finding present issues. Though suitable utilization will be found high suitable and more to acceptance range,, ANNs offer attractive ultimate, and plenty of utilization may useful through ANNs techniques[3][4].

C. Definition of Neural network:

In general ANN as shown in the Fig-1 could be a well defined system that's structured to model the method like the human thinking performs a selected operation assigned as required. To attain smart operation behavior, they use an enormous network designed of straightforward analysis cells remarked as 'units of 'processing or also called neurons.

A neural network may be a more designed complex parallel distributed system created to straightforward processing,, This features a common experimental data and creating out it to be used.

It is very similar to human thought principles mostly in following two respects with the support of brain cells.

1. The properly learning method provides acceptance of various information's from processing on computing.
2. Adaptiviness of the network structure make the processing of data's more flexible and reliable with proper design structure.

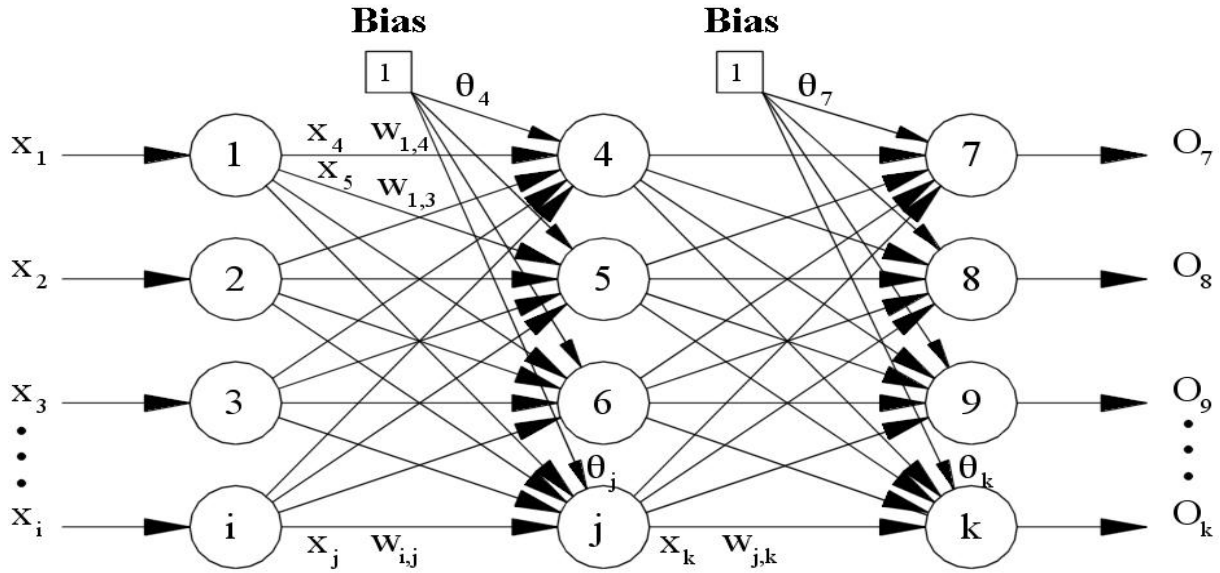

Fig.1 Common form of ANN structure for channel equalization

II. HYPOTHESIS

A. Scope

The ANN based system has more computational ability .Well defined network linking parallel and, second, its capability of giving output in very common ways. The usability of neural networks provides many more helpful characteristic and capabilities:

- Complex well defined structure
- Wide network of correlation and computing action
- ability over Generalization
- proper mapping to Input-output data
- High Adaptive in nature
- clear Analysis and Uniformity of Design
- tolerance over expecting Fault

The latest acceptance of neural networks provides the structural model to the adaptive systems may be also nonlinear and offer a good label of preciseness. When we look into addictiveness and flexibility and tolerance over expecting faults nature, it is better than other system representation .Hence ANN are highly acceptable optimizing tools consider for high rate of data transmission[5][6].

B. Need for nonlinear equalizers:

On the pass band limit the linear nesses of equalizer cannot provide better outcome for the channels associated in deep spectral nulls. In general this limitation of distortion loss cans be avoided with an excessive amount of gain within the locality,

Non-linear equalizers output perform the linear equalizers in terms of BER. Conjointly the linear equalizers read effort as inverse issues whereas non-linear equalizers read effort as a pattern classification issues.

Consider the subsequent states for the two channels.

$$H_1(Z) = 1 + O.5Z^{-1}$$

$$H_2(Z) = 0.3842 + 0.8704Z^{-1} + O.3842Z^{-2}$$

B. ANFIS Architecture:

III. METHODOLOGY

A. The ANFIS Equalizer:

ANFIS is an adaptive learning algorithmic rule where all the individual parameters are optimized with support of various available information at both the input output terminal for existing fuzzy mechanism. The standard structure of fuzzy and neural network together provides a better platform. The membership function and required parameter associate with it, is responsible for mapping both the input and output[9].

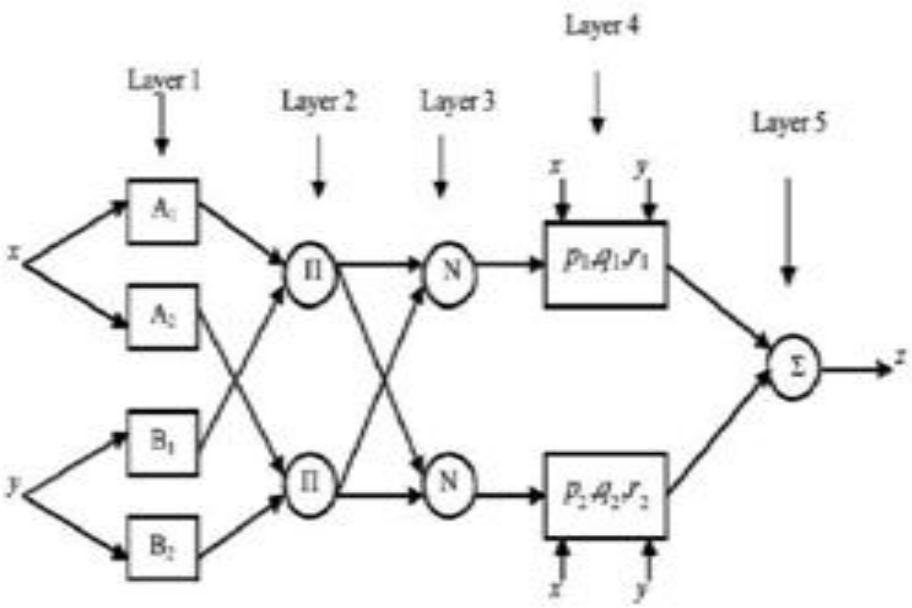

Fig.2 Architecture of ANFIS system

ANFIS architecture given in Fig2 has two input and one output. In the given architecture diagram circle as fixed and square as adaptive nodes.

The standard rules of fuzzy operation i.e IF-THEN describing the hybrid system that express as

Let Ai and Bi are two fuzzy set

p_i, q_i and r_i trained data during the process of ANN training.

This designed structure of ANFIS having following level.

Level 1

$Q_{1,i}$ be the activation function of first layer for node 1.This process to output of the corresponding node in 1st level.

For I - 1, 2, $Q_{1,I} = (x)$

for I = 3 ,4

$Q_{1,I} = (y)$

the membership function , linguistic term and input are express in terms of μ_{Ai}, nodes 1 and 2, x, Ai respectively. in sameway for node 3 ,4 is y, Bi-2, and μBi-2

Level 2

Every node available here has output activation function and its functioning and the output node is the product of all incoming signal.

Level 3

The node 1output for this level achieved through normalized activation character strength as w_i

Rule 1:

If x is A_1 and y is B_1, then $z_1 = p_1x+q_1y+r_1$

Rule 2:

If x is A_2 and y is B_2, then $z_2 = p_2x+q_2y+r_2$.

Level 4

This layer has properties of node function for every node, with all previous properties of weight of the corresponding link and activation function of corresponding nodes.

Level 5

Node of output layer with activation function Q_5 is the collected outcome.

C. ANFIS Structural Diagram:

The channel equalizer proposed here given through Fig .3 is the ANFIS based.

Let y(k)={y(k) y(k−1)……y(k-m+1)} is input to the equalizer.

Where transmitted signal is I (k) and Î (k)

An estimate of the transmitted signal can be expected from output of channel equalizer [7].

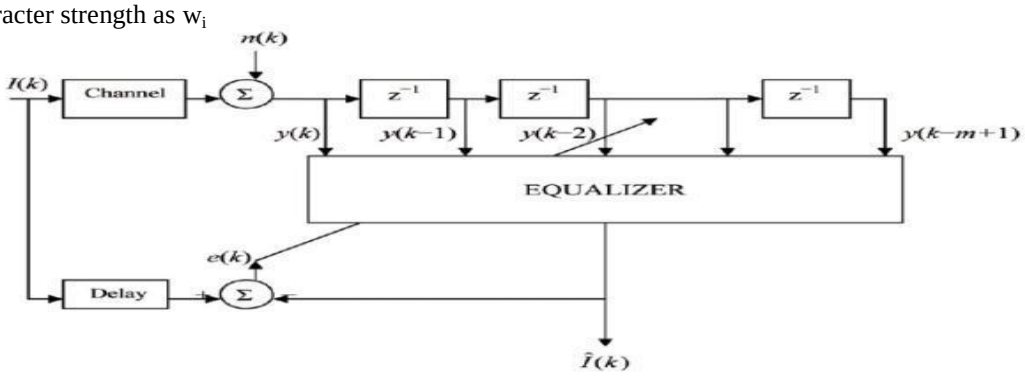

Fig.3 The ANFIS Based Channel Equalizer

IV. SIMULATION AND SYSTEM ANALYSIS

One of the simulation result as shown in the Fig-4.Here representing presently designed equalizer output with MLP and LMS equalizer system with proposed error rate of bit associateting.for all channels available. In Common BER outcome of the proposed equalizer is very similar among themselves. It is observed that for MLP and LMS equalizer bit error rate decrease further with non-linearness and provides a better agreement over required characteristics in terms of operation and design nature [8][10].

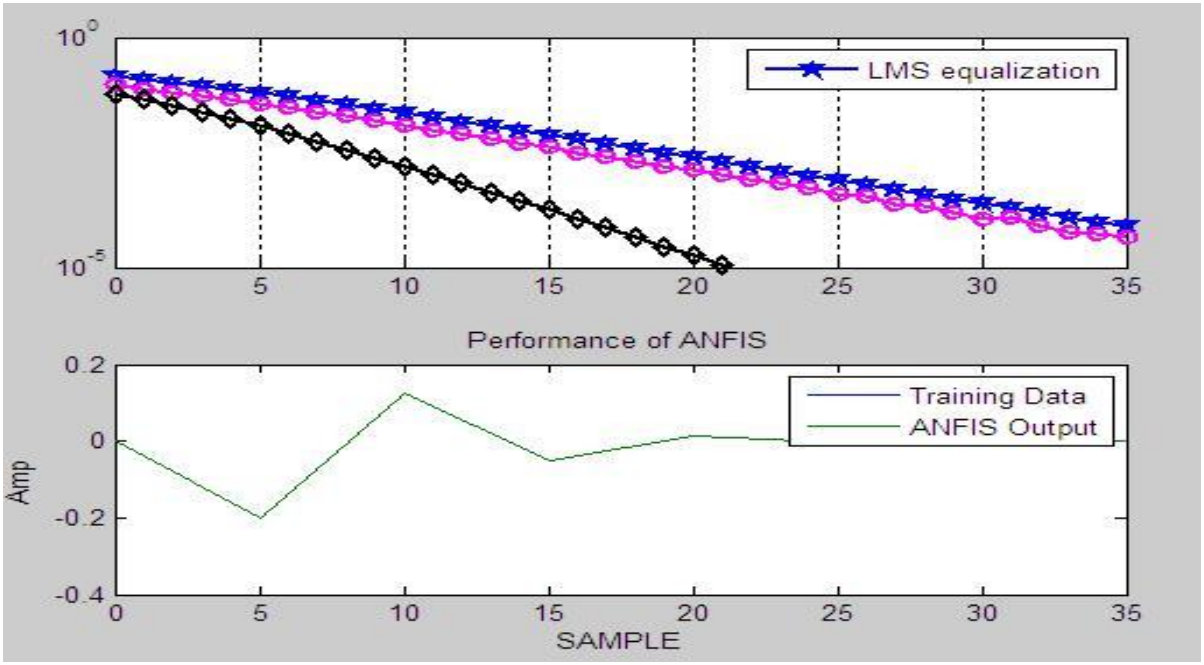

Fig 4 Simulated result using ANFIS.

V. CONCLUSION

Through this paper a properly designed equalizer supported with ANFIS expecting better usefulness in communication system. Its operational behavior is analyzed with reference to present existing bit rate .comparison with LMS, MLP,RBF and Bayesian classification techniques has been taken to look into the suitability of this . Channel equalization as. This study also help further in regulating bit error rate for designing proper channel equalizer towards upcoming communication demands.

REFERENCES

1. Wei Ying Lim and Zhongding Lei, "JointMMSE Precedingand Detection for Interference Alignment in MIMO channels", IEEE, 2012.
2. Hongliang Mao, Yukui pei and Ning Ge, "FullDiversity Achieving MMSE Frequency-Domain Equalizer for Single-carrier Block Transmission with DSSS", IEEE, 2012.
3. Rafik ZAYANI, MohamedL. AMMARI, "NeuralNetwork Equalizationf on Frequency Selective Nonlinear MIMO Channels", IEEE, 2012
4. Cheng-Yu Hung, Wei-Ho Chung and Chiao-En Chen, "AMonte Carlo MIMO Detection Via RandomNoise Generation", IEEE, 2012.7) Volume 16–No.7, February 2011.
5. N.Sathish Kumar, Dr. K.R.Shankar Kumar,"Performance Analysis of M*N Equalizer based Minimum Mean Square Error (MMSE) Receiver for MIMO Wireless Channel",International Journal of Computer Applications (0975 –8887)Volume 16–No.7, February 2011.
6. Thamer M. Jamel: " Performance Enhancement of Smart Antennas Algorithms for Mobile Communications System" :INTERNATIONAL JOURNALOF CIRCUITS, SYSTEMS AND SIGNAL PROCESSING Volume 8, 2014
7. Peng Xu et.al : "Analysis and Design of Channel Estimation in Multicell Multiuser MIMO OFDM Systems" IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY, VOL. 64, NO. 2, FEBRUARY 2015 page no. 610-620
8. Sunho Park : ""Iterative Channel Estimation Using Virtual Pilot Signals for MIMO-OFDM Systems" IEEE TRANSACTIONS ON SIGNAL PROCESSING, VOL. 63, NO. 12, JUNE 15, 2015
9. Charles U. Ndujiuba et.al :"Dynamic Differential Modulation of Sub-Carriers in OFDM" Journal of Wireless Networking and Communications 2016, 6(1): 21-28.
10. Han Wang et.al: "A New Sparse Adaptive Channel Estimation Method Based on Compressive Sensingfor FBMC/OQAM Transmission Network" MDPI, sensors 2016 page no. 2-12.

AUTHORS PROFILE

Mr Ami Kumar Parida, Research scholar in Electronics and communication engineering at SSSUTMS, Bhopal .He has 9 years of teaching experience under GIET University, Odisha.

Dr Subodh Kumar Panda presently working as an Associate professor at GIET University, Odisha .He has 20 years of teaching and industrial experience with more than 30 research publications in international journal and conferences.

Dr. R.P. Singh, Vice chancellor SSSUTMS is former Director and Prof. Electronics and Communication at MANIT Bhopal. He has published more than 125 papers in National / International reputed and indexed Journals including SCI. More than Twenty candidates have completed their Ph.D. under his supervision in the area of Electronics Communication System and related disciplines.