# ON SOME ASPECTS OF CHANNEL ESTIMATION AND EQUILIZATION

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With the growth of computer communication technologies, efficient high speed data transmission techniques over communication channels have become an important topic for research. A signal transmitted over a channel suffers from linear, nonlinear and additive distortions. The linear and nonlinear distortions cause the transmitted symbols to spread in time and overlap over successive time intervals, resulting the adjacent pulses to interfere with each other that is popularly known as intersymbol interference or ISI. Other factors like thermal noise, impulse noise, cross talk and the nature of the channel itself cause further distortions to the transmitted symbols over the communication channel. Signal processing techniques used at the receiver end to reduce the effect of these distortions so as to restore the transmitted symbols and recover their information, are referred as channel equalization or simply equalization. Classical estimation theory suggests that best performance for symbol detection is obtained by using a maximum likelihood sequence equalizer (MLSE) for the entire symbol sequence, which involves a batch-processing scheme. Classical approaches to the equalization problem have focused on exploitation of the constant modulus property or discrimination based on higher order statistics. One of the principle drawbacks of these techniques is that they tend to converge very slowly. Computational complexity and low rate of convergence of the classical equalization methods has led to the popularity of the equalizers that make decisions symbol by symbol as an alternative. The optimum solution for these symbol decision equalizers has been approached using the Bayesian decision theory. It can be seen from the Bayesian solution that the optimal solution corresponds to a nonlinear classification problem.

To deal with the channels that introduce nonlinear distortions, there has been recent interest in applying neural networks such as multi layer perceptron(MLP) and radial basis function (RBF) networks in adaptive equalization of data communication channels. The basic idea of applying artificial neural network (ANN) to equalization problem comes from the fact that equalization problems can be regarded as nonlinear classification problem. Initial studies have demonstrated that neural network equalizers are superior to conventional transversal and decision feedback equalizers (DFE) in terms of equalizer performance.

In the present work an attempt has been made to explore in depth the artificial neural network (ANN) structures for the development of equalizers for the equalization of digital communication channels. The proposed work provides a new solution to overcome the nonlinear distortions introduced by the digital communication channels. A new Feed forward neural network structure has been used for the development of channel equalizer. To study the performance of the ANN equalizer finite impulse response (FIR) channel model has been considered. The transmitted binary sequence are chosen from {-1 ,+1}, with equal probability. They are independent and identically distributed. The additional distortion in the channel has been modeled as white Gaussian noise. For training the equalizer a training sequences of 1000 symbols are used. After training the equalizer has been tested for 10,000 symbols. Bit error rate (BER) and mean square error (MSE) are used as performance measure in the simulation. The proposed ANN models have been simulated using MATLAB 6.0 version. The performance of the proposed ANN equalizer models have been compared with the earlier equalizer models reported in the literature and it has been found that our proposed model gives better results than the existing models while retaining its simplicity.

The neuron in an artificial neural network (ANN) is basic computational element. There exists a massive parallelism between the neurons of adjacent layers of the neural network. There are three important parameters that govern the complexity and performance of an artificial neural network model; number of layers, number of neurons in each layers and the activation functions for the neurons in each layers. While increasing the number of layers and the number of neuron may increase the performance of the ANN model, it may also leads to the computational complexity of the network. In the present work different ANN structures have been used by varying the number of layers and the number of neurons in the layers to model the channel equalizer and performance of each model has been critically examined and compared with each other.

Finally, we have also attempted here to study the effect of different activation function on the performance of the ANN equalizer and the number of epochs required for the training of the network to achieve the specified goal.