ARTIFICIAL NEURAL NETWORK BASED LOAD FORECASTING

Gaurav Lal Vyas[1] , Ms. Swati Gaur[2]

[1]Mtech student, Dept. of Electronics and Communication Engineering, Delhi College of Technology and Management, Palwal(Haryana), India
[2]Assistant Professor, Dept. of Electronics and Communication Engineering, Delhi College of Technology and Management, Palwal(Haryana), India

---

Abstract: *A large number of researchers have advised the artificial neural network technique for forecasting of load. This paper studies the technique for load forecasting using two training algorithms and comparing their applicability and efficiency. For this purpose, a literature survey was conducted. Most of the algorithms are based on the Multiple Layer Perceptron (MLP). The results are good but it can be improved. So an equally popular adaptive algorithm – the least mean square (LMS) algorithm was used. By using the LMS algorithm the error rate was decreased and the results improved.*

Keywords:- Multiple Layer Perceptron (MLP) , Least Mean Square (LMS), Artificial Neural Network (ANN)

1. INTRODUCTION

The concept of the artificial neural network was derived from the fact that the human brain computes in a different manner from the computers. The brain is a highly complex and parallel information processing system. The brain can perform certain computations many times faster than the most advanced and fastest digital computers existing today. A machine that is designed to model the way in which the brain performs a particular function is termed as neural network. Implementation of this network is performed by using electronic components or is stimulated in software on a digital computer. A neural network is a massively parallel distributed processor. It is made up of simple processing units, which has a natural propensity for storing experimental knowledge and making it available. The procedure used to perform the learning process is called learning algorithm. The function of the learning algorithm is to modify the synaptic weights of the network in an orderly manner to attain a desired design objective.

1.1 History of ANN

Artificial neural network is a recent development. Many important developments have been boosted by use of inexpensive computer emulations. Initially the field survived a period of frustration and disrepute. Minsky and Papert, published a book (in 1969) in which they mentioned a general feeling of frustration against the neural network field . In the present era the field has developed a good interest and the funding is also increased. The first artificial neuron was developed by the neurophysiologist Warren McCulloch and the logician Walter Pits in 1943.

2. LOAD FORECASTING

Load forecasting is one of the important functions in power systems operation. The electricity cannot be stored that's why for the efficient utilization the estimate of the future demand is essential. Knowledge of the demand helps in management of the production and purchase of the electricity. Load forecasting methods can be divided into long-term, medium-term and short-term models. This work is based on the short-term load forecasting. This paper studies the applicability of two different training algorithms on short term load forecasting.

2.1 ANN MODEL

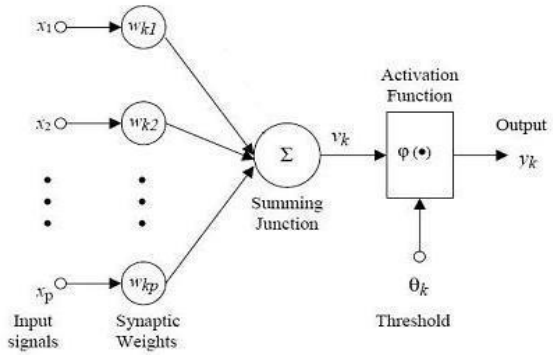

Figure 1. Model Of ANN

2.2 LEARNING PROCESS

The purpose of learning rule is to train the network to perform some task. They fall into three broad categories:

1. Supervised learning

The learning rule is provided with a set of training data of proper network behavior. As the inputs are applied to the network, the network outputs are compared to the targets. The learning rule is then used to adjust the weights and

biases of the network in order to move the network outputs closer to the targets.

2. Reinforcement learning

It is similar to supervised learning, except that, instead of being provided with the correct output for each network input, the algorithm is only given a grade. The grade is a measure of the network performance over some sequence of inputs.

3. Unsupervised learning

The weights and biases are modified in response to network inputs only. There are no target outputs available. Most of these algorithms perform some kind of clustering operation. They learn to categorize the input patterns into a finite number of classes.

3. FLOW CHART

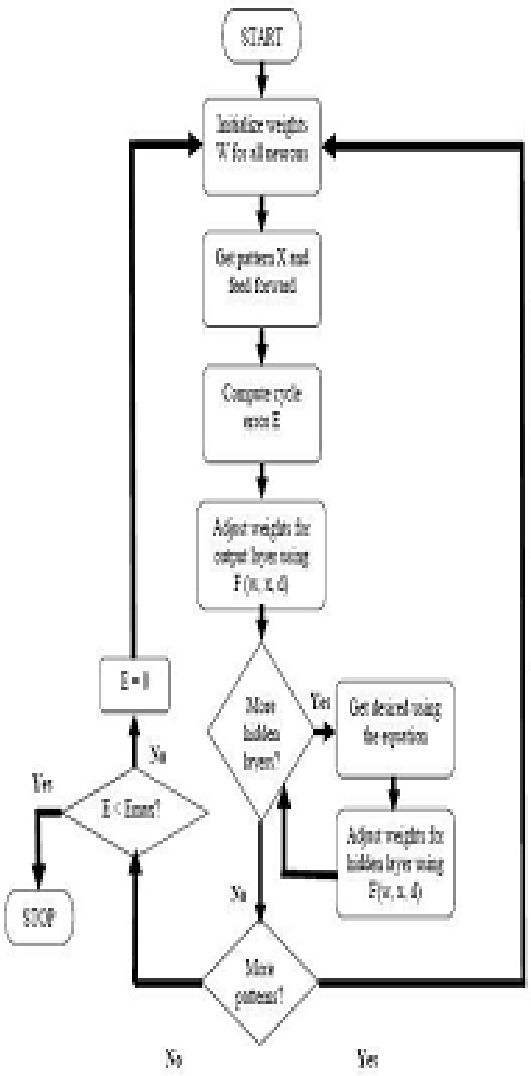

Figure 2. Flow Chart

4. TRAINING

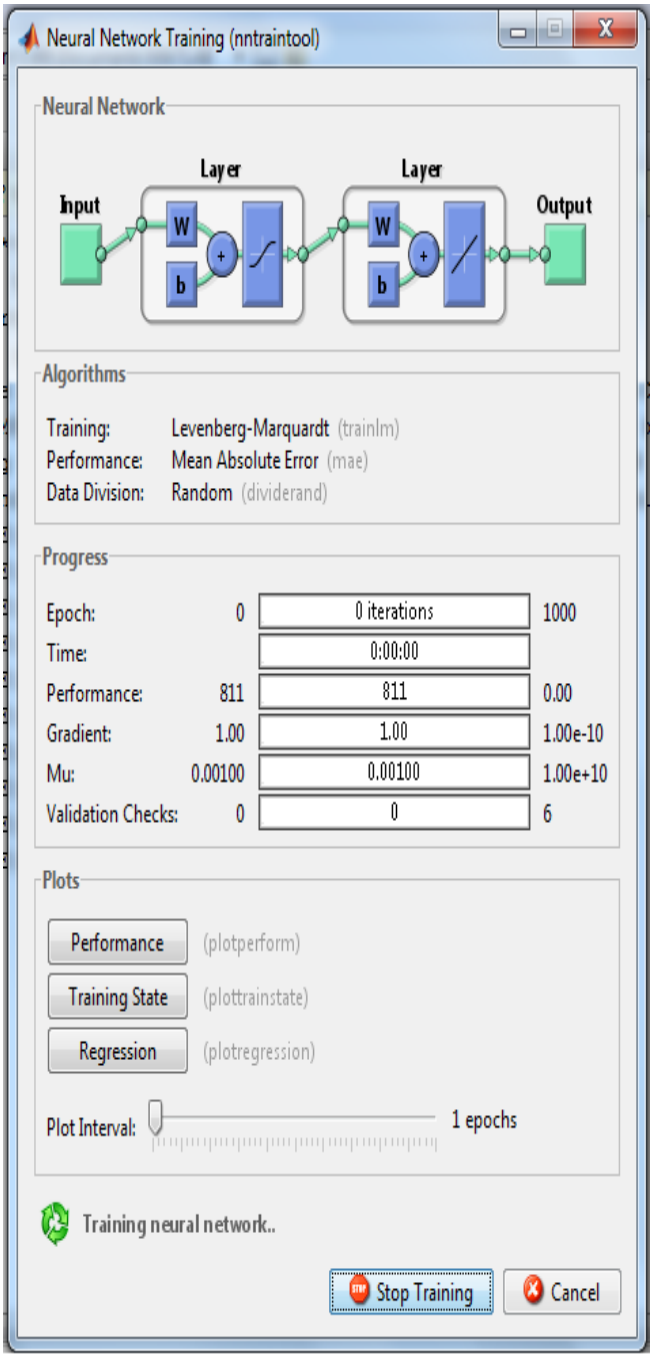

Figure 3. Neural Network Training GUI in MATLAB

5. SIMULATION RESULTS

The inputs were fed into our Artificial Neural Network (ANN) and after sufficient training were used to predict the load demand. For our Neural Network model we used a Multi Layer Perceptron (MLP) network with a single hidden layer. The output graph obtained between the actual load and predicted load is shown in figure 4.

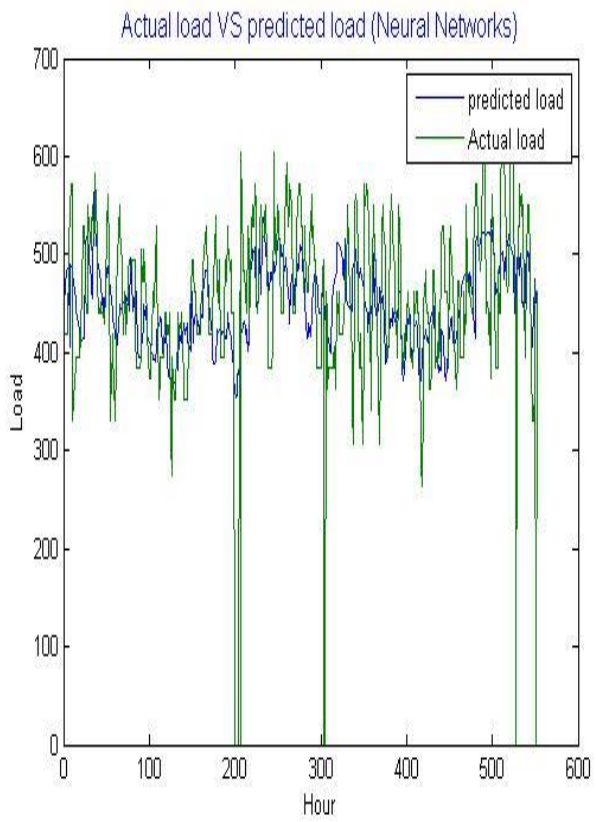

Figure 4. Actual v/s Predicted Load

The output graph obtained between actual load and forecasted load is shown in figure 5.

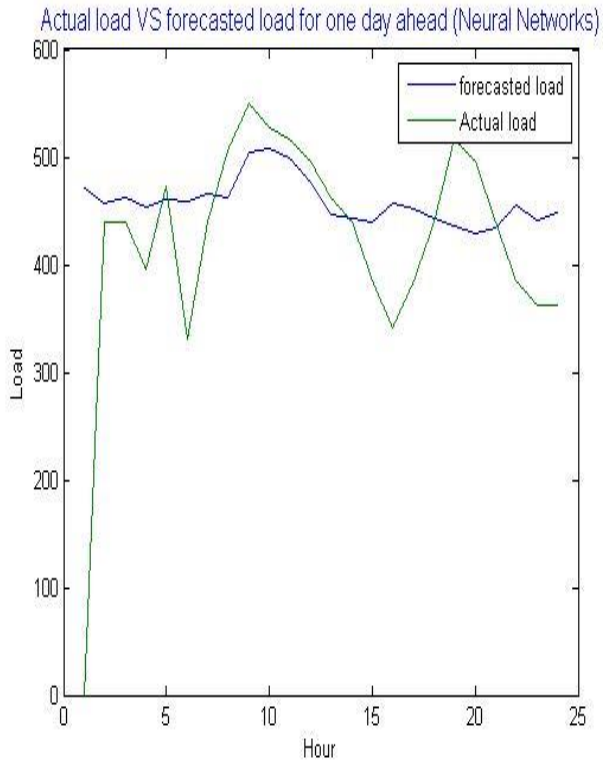

Figure 5. Actual v/s Forecasted Load

The mean absolute percent error (MAPE) for this algorithm comes out to be 11.424 %.
When the least mean square (LMS) algorithm is used the efficiency of the system increased. The output graph obtained between actual load and forecasted load is shown in figure 6.

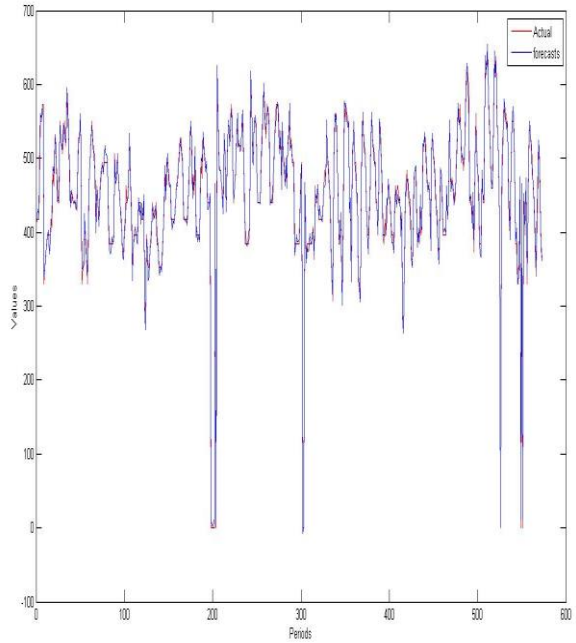

Figure 6. Actual v/s Forecasted Load

6. CONCLUSION

ANN models are a very useful tool for short term load forecasting. These models have shown good results in load forecasting. Study in a comparative manner of both the algorithms shows that the MLP algorithm is less promising than the LMS algorithm. Its forecasting reliabilities were evaluated by computing the mean absolute error between the exact and predicted values. The mean absolute percent error (MAPE) in case of LMS algorithm comes out to be 2.64 % which is a good result and represent a high degree of accuracy. The results suggest that ANN model with the developed structure can perform good prediction with least error and finally this neural network could be an important tool for short term load forecasting. Future studies on this work can incorporate additional information (such as customer class and season of the year) into the network so as to obtain a more representative forecast of future load. Network specialization (i.e. the use of one neural network for the peak periods of the day and another network for the hours of the day) can also be experimented upon.

REFERENCES

[1] C. N. Lu, H. T. Wu and S. Vemuri, "Neural Network Based Short Term Load Forecasting", IEEE Transactions on Power Systems, Vol. 8, No.1, February 1993.

[2] K. Y. Lee, Y. T. Cha and J. H. Park, "Short-Term Load Forecasting Using an Artificial Neural Network", *IEEE Tr. on Power Sys*., vol. 7, No. 1, pp. 124-132, Feb 1992

[3] R. P. Schulte, G. B. Sheble, S. L. Larsen, J. N. Wrubel and B. F. Wollenberg, "Artificial Intelligence solutions to Power System Operating problems", IEEE Transactions on Power Systems, Vol. PWRS-2, No.4, November 1987.

[4] W. Charytoniuk and M. S. Chen, "Very Short-Term Load Forecasting using Artificial Neural Networks", *IEEE Tr. On Power Sys*., vol. 15, No. 1, pp. 263-268, Feb 2000.

[5] Bakirtzis, A. G., J. B. Theocharis, S. J. Kiartzis, K. J. Satsios, "Short term load forecasting using fuzzy neural networks", IEEE Transactions on Power Systems, Vol. 10, No.3, August 1995, pp. 1518-1524.

[6] T. S. Dillon, and D. Niebur, *Neural Networks Applications in Power Systems*, CRL Publishing, London, UK, 1996.

[7] Campo, R. and P. Ruiz,"Adaptive weather-sensitive short-term load forecast", IEEE Transactions on Power Systems, Vol. PWRS-2, No.3, August 1987, pp. 592-600.

[8] Chen, S.-T., D. C. Yu, A. R. Moghaddamjo, "Weather sensitive shortterm load forecasting using non-fully connected artificial neural network", IEEE Transactions on Power Systems, Vol. 7, No.3, August 1992, pp. 1098-1102.

[9] A. Khotanzad, R. Afkhami-Rohani and D. Maratukulam, "ANNSTLF – Artificial Neural Network Short-Term Load Forecaster – Generation Three", *IEEE Tr. on Power Sys*., vol. 13, No. 4, pp. 1413-1422, Nov 1998.

[10] Djukanovic, M., B. Babic, D. J. Sobajic, Y.-H. Pao, "Unsupervised/supervised learning concept for 24-hour load forecasting", lEE Proceedings-C, Vol. 140, No.4, July 1993, pp. 311-318.

[11] A. Cichoki and R. Unbehauen, *Neural Networks for Optimization and Signal Processing*, John Wiley & Sons, Stuttgart, Gb,1993.

[12] Gross, G., F. D. Galiana, "Short-term load forecasting", Proceedings of the IEEE, Vol. 75, No. 12, December 1987, pp. 1558-1573.

[13] Ho, K.-L., Y.-Y. Hsu, C-C. Yang, "short-term load forecasting using a multiplayer neural network with an adaptive learning algorithm", IEEE Transactions on Power Systems, Vol. 7, No.1, February 1992, pp. 141-148.

[14] J. A. Jardini, S. U. Ahn, C. M. V. Tahan, et al, "Residential and Commercial Daily Load Curve Representation by Statistical Functions for Engineering Studies Purposes", *CIRED*, 1, pp. 5.23.1-6.

[15] Hsu, Y.- Y., C.-C. Yang, "Design of artificial neural networks for shortterm load forecasting. Part I: Self-organizing feature maps for day type selection", lEE Proceedings-C, Vol. 138, No.5, September 1991, pp. 407-413.