International Journal of Scientific Research in Science and Technology
Print ISSN: 2395-6011 | Online ISSN: 2395-602X (www.ijsrst.com)
doi : https://doi.org/10.32628/IJSRST229152

Review on Analysis of Power Supply and Demand in Maharashtra State for Load Forecasting Using ANN

Suraj G. Patil[1], Dr. M. S. Ali[2]
[1]ME Scholar, Electrical Engineering Department, Prof. Ram Meghe College of Engineering and Management, Badnera, Amravati, India.
[2]Professor, Electrical Engineering Department, Prof. Ram Meghe College of Engineering and Management, Badnera, Amravati, India.

Article Info
Volume 9, Issue 1
Page Number : 341-347

Publication Issue
January-February-2022

Article History
Accepted : 11 Feb 2022
Published : 24 Feb 2022

ABSTRACT

The Electric load forecasting (ELF) is a critical procedure in the electrical industry's planning and plays a critical role in electric capacity scheduling and power system management, hence it has piqued academic attention. As a result, for energy generating capacity scheduling and power system management, the accuracy of electric load forecasting is critical. This document provides an overview of power load forecasting methodologies and models. A total of 40 scholarly publications were included in the comparison, which was based on certain criteria such as time frame, inputs, outcomes, project scale, and value. Despite the relative simplicity of all studied models, the regression analysis is still extensively employed and effective for long-term forecasting, according to the research. Machine learning or artificial intelligence-based models such as Artificial Neural Networks (ANN), Support Vector Machines (SVM), and Fuzzy logic are preferred for short-term forecasts.

Keywords: Short term load forecasting, Back Propagation, Artificial Neural Network.

I. INTRODUCTION

Power utilities are needed to supply reliable power to consumers. Within style stages, utilities have to be compelled to set up ahead for predictable future load development underneath totally different attainable situations. Their choices and styles will have an effect on the profit or loss of crores of rupees for his or her organizations/utilities moreover as client fulfilment and future monetary process in their space. For efficient operation and planning of utility company, correct models of power load prediction are necessary.

Load forecasting is a very essential tool for an electrical utility to form necessary choices together with choices on the purchase, also for banking of power (with alternative corporations or identical state utilities or with the neighbouring states), in the generation of power, in load change and development in infrastructure [1]. It is very necessary for energy suppliers as well as for other alternative participants within the electrical energy transmission, generation, distribution, and markets.

For electric utilities, accurate forecasting of load accurately plays an awfully necessary role due to exceeding cutthroat competitive surroundings shaped by the electric business deregulating. An electric company is confronted with several economists and technical operational issues, along with planning and management of a utility electric system since customers should be provided electricity of high-quality in an exceedingly efficient and safe manner [1]. Load forecasting is also beneficial for an electric utility in creating necessary selections on generating, interchanging, and buying wattage, load change. Besides this, it is important for suppliers' utility, many establishments and others concerned with the electric energy generation and regulation [2].

II. LITERATURE REVIEW

There is far diversity in the load forecasting and its strategies so it's unattainable to enrich them within the restricted time duration. So, in this part of the introduction, the literature review on load forecasting and techniques is briefly summarized. This literature review about other topics is also discussed below. A revealed literature review is divided into 5 main parts:

(i) Multiple Regression Method

One of the foremost wide used statistical approaches is a regression. For load forecasting, multiple regression strategies are sometimes utilized to relate link between load utilization and alternative elements like day type, weather and client category.

Nikolic et al. [3] conferred that for consecutive day load forecasting there are many multiple regression models. Their models incorporate settled significances like stochastic influences, holidays like exogenous influences and average loads like the weather. [4–6] express alternative purpose of multiple regression models exercised to load forecasting.

(ii) Time Series

The time series methodology is created on the assumption that information has several internal structures resembling trends, seasonal variation or autocorrelation. Uttermost typically used traditional time series strategies are a unit ARIMA (autoregressive integrated moving average), ARMA (autoregressive moving average), ARIMAX (autoregressive integrated moving average with exogenous variables) and ARMAX (autoregressive moving average with exogenous variables). Implementations of ARIMAX models for load forecasting have been presented by Fan and McDonald [6] and Cho et al [7]. A unique hybrid algorithmic rule for price/load forecasting. The hybrid algorithmic rule is classed into 3 parts; versatile wavelet packet transform, multi-input-multi-output (MIMO) model and autoregressive integrated moving average (ARIMA), artificial bee colony (ABC) algorithmic rule supported time-varying coefficient and stumble generation operator that's referred to as TV-SAC. Yang et al. [8] used Associate in nursing evolutionary programming (EP) approach to spot the ARMAX model parameters for some unspecified time in the future so that there should be hour load demand forecast at least one week ahead. The EP could be a technique for simulating evolution and constitutes a stochastic optimal algorithmic rule. In [9] multi-input-multi-output (MIMO) model has been used for the correlation between electricity value and load. The model encompasses 3 elements referred to as wavelet packet transform (WPT), generalized mutual data (GMI) and least square support vector machine (LSSVM). A fuzzy autoregressive moving average with exogenous input variables (FARMAX) at some unspecified time in the future ahead hourly load forecasting is projected by Yang and Huang [10].

(iii) Expert System

Discussing the short-term forecasting for power grid based in Taiwan, Ho et al. [11] present the knowledge-based skilled system. Based on the hourly recorded data of system load and various weather parameters for five years along with the local operator's information, the forecasting has been

performed. Presenting the location independent short-term forecasting technique, Rahman and Hazim [12] discussed the various factors affecting the forecasting and represented them in the parametric form as a defined rule base. Whereas, this rule base is dependent upon the location and varies accordingly. The results, considering location independent forecasting for various sites shows the approach to be fit, i.e., gives low forecasting errors. Thus, irrespective of the forecasting location, the load model, developed rule base system and the other parameters have been designed.

(iv) Fuzzy Logic

Presenting the fuzzy logic approach for load forecasting, in [13] various fuzzy based models based on the recorded data for two years, i.e., 2009-2011 have been shown. The work discusses the fuzzy logic-based forecasting of the load for the off-days, i.e., holidays. The results show accurate load forecasting and thus its benefits to the power system (in terms of economic load dispatch). Overcoming the statistical forecasting approaches which included the mathematical formulation of the given problem, fuzzy logic based forecasting approach is solely dependent upon the rule base designed in fuzzy toolbox [14]. Thus, the approach proves to be robust in the area of load forecasting. Also, as discussed by [15], the drawback of various forecasting tools and approaches, i.e. absence of crisp output is a major issue. Hence, in the fuzzy logic based base gives a crisp output value. Working on the validation of fuzzy logic based forecasting approach, the results of fuzzy depending upon the data of 1 year and for ANFIS compared with the online load data, shows MAPE to be 2.1 and 1.85. Presenting a comprehensive review of the various forecasting methodologies, [16] discusses the need, advantages and various applications of fuzzy logic based forecasting approach. Comparing the performance of fuzzy logic based system with back propagation neural network method based on historical data, shows the later to be more complex and difficult to understand in comparison to fuzzy logic models.

(v) Neural Networks

With the awareness of neural network approach in the area of forecasting, in the year 1990, the approach was first time developed for the problem of load forecasting. With parallel and distributed units for processing, the neural network can be defined as the set of arrays including series of the repetitive uniform processor while connected to the grid. In a neural network, the two important key terms are learning and training. The learning in NN can be done by various methods like interconnecting the various processors of NN with each other [17]. Using the Neuroshell-2, in [18] short-term load forecasting have been done. Based on the neural network approach and other systems like the Expert system, Grey system theory and artificial neural network [19], the short term load forecasting gives satisfactory results. Comparing the forecasting system in real time with the available data shows NN tool to be more accurate and reliable. Focusing on the advantages of back propagation type neural network in load forecasting, it can be defined as a multilayer feed forward neural network (FFNN) consisting of a nonlinear function and a transfer function.

Discussing the properties of BP, The transfer function that can be obtained from the network will be linear or nonlinear input of the network depends upon the input to the network and the number of layers can also be increased up to 3 or 4 as required. It can also be fully connected or partially connected. The network of neural may be fully connected or non-fully connected. In [16] [20-22] the neural network is designed which is a three-layer network having a transfer function as a nonlinear sigmoid function in the short-term load forecasting. In [23] brand new technique has been utilized that is global best particle swarm optimization (GPSO) to boost the performance

of ANN. To get the higher training, performance, convergence characteristics and forecast accuracy the ANN, GPSO, and BP techniques have been used. In [24] the input layer to the output layer has been planned to get the standard sigmoid function and a linear transfer function. In [25] BP model is planned. it can be understood that the results obtained from the ANN was ready to have load characteristics, even though a partially connected ANN is favorable for replacing the temperature changes. Apart from this, [25] better forecasting results can also be obtained by the combination of several sub-ANN with the help of STLF approach. In [26] well planned recurrent high order neural network (RHONN). A 3-layer ANN through appropriate dimension is spare to estimate any uninterrupted non-linear function [26]. Load forecasting using a four-layer formation is enforced and the structure was reported in [11], [17], [27].

BP network can be a fair array which can see nonlinear mapping from input to output. After this, the choice of the input variable of load prediction network is of great importance. Generally, there are 2 options strategies. An expertise depends on [11], [17], [20], [24] and this option depends on statistical analysis related to ARIMA [25] and correlation analysis. Input variables are usually determined by engineering decisions and skills. In order to collect all things, the input variable can be grouped into five fundamental classes:

1. Historical loads [17-21], [24-26], [28].
2. Temperature [17-20], [24-25], [28].
3. Relative humidity [28].
4. Hour of day index [17], [20], [25].
5. Day of the week index [17], [25].

Intensive study on the effects of factors related to learning phase, bpm is presented by the authors of the motion factor [22]. He investigated a learning algorithm for adaptive training of neural networks. For the complete error function is employed in a predefined learning algorithm [29] by the principle of "forced dynamic". The rate of modification of the network weight is given priority, for reducing the error function is forced to "decay" through a shear mode. In the direct proportion of the total error, the partner approach to change the weight is in [30]. With this, the period of the postponement zone unit is very short and the risk of the crowd in the country minimum has been greatly reduced. With this, the periods of stagnation area unit a lot of shorter and also the risk of tack in native minima are greatly reduced.
ANN can only perform operations according to the trained data whereas in case of STLF the selection of training sets was quite complicated. The selection was based on the similarity of characteristics of the training pairs present in the training set must be same as those to the forecasted in that day. To get smart forecasting results, day type data should be taken under consideration. A technique is to construct the various ANNs for everyday type and fed every ANN with the corresponding day type training sets [28]. The opposite is to use only one ANN, however, contain the day type data within the input variables [17], [21], [25]. The previous uses a variety of comparatively little size networks, whereas the latter has only one network of a comparatively giant size. A typical classification given in [17] categorizes the historical loads into 5 categories. These are a Monday, Tuesday-Thursday, Friday, Saturday and Sunday/Public vacation. The traditional ways to use observation and comparison [17], [24], and was supported unsupervised ANN ideas and selects the training set automatically [11], area unit used for day type classification.

III. CONCLUSION

The forecasting models have been studied in greater depth in this work, which is based on 40 of the most significant scholarly papers on electric load forecasting. Several factors, such as the project's scale, the forecast horizon time frame, temporal resolution, inputs, outputs, data pre-processing, and so on, have

been checked and examined. The study also looked into some of the common patterns in the use of these models. Regression analysis-based models and artificial neural networks (ANN), which are the most commonly used models in electricity predictions, are some of the more suited and recommended models for electric load projections. Artificial neural networks (ANN) models are mostly used in this context for short-term forecasting where electricity and power consumption patterns are more complex.

IV. REFERENCES

[1]. Rothe, J. P., A. K. Wadhwani, and S.Wadhwani. "Hybrid and integrated approach to short term load forecasting". International Journal of Engineering Science and Technology, vol.2, no. 12, pp.7127-7132, 2010.

[2]. J. H. Chow, "Applied Mathematics for Restructured Electric Power Systems: Optimization, Control, and Computational Intelligence". New York: Springer-Verlag, 2005, ch. 12.

[3]. Ruzic, S., Vuckovic, A. and Nikolic, N., "Weather sensitive method for short term load forecasting in electric power utility of Serbia". IEEE Transactions on Power Systems, vol.18, no. 4, pp.1581-1586, 2003.

[4]. Hyde, O. and Hodnett, P.F., "An adaptable automated procedure for short-term electricity load forecasting". IEEE Transactions on Power Systems, vol. 12, no. 1, pp.84-94, 1997.

[5]. Haida, T. and Muto, S., "Regression based peak load forecasting using a transformation technique". IEEE Transactions on Power Systems, vol. 9, no. 4, pp.1788-1794, 1994.

[6]. Charytoniuk, W., Chen, M.S. and Van Olinda, P., "Nonparametric regression based short-term load forecasting". IEEE Transactions on Power Systems, vol. 13, no.3, pp.725-730, 1998.

[7]. Fan, J.Y. and McDonald, J.D., "A real-time implementation of short-term load forecasting for distribution power systems". IEEE Transactions on Power Systems, vol. 9, no. 2, pp.988-994, 1994.

[8]. Ghasemi, A., Shayeghi, H., Moradzadeh, M. and Nooshyar, M., "A novel hybrid algorithm for electricity price and load forecasting in smart grids with demand-side management". Applied energy, vol. 177, pp.40-59, 2016.

[9]. Fogel, D.B., "An introduction to simulated evolutionary optimization". IEEE Transactions on Neural Networks, vol. 5, no. 1, pp.3-14, 1994.

[10]. Shayeghi, H., Ghasemi, A., Moradzadeh, M. and Nooshyar, M., "Simultaneous day-ahead forecasting of electricity price and load in smart grids". Energy Conversion and Management, vol. 95, pp.371-384, 2015.

[11]. Yang, H.T. and Huang, C.M., "A new short-term load forecasting approach using self-organizing fuzzy ARMAX models". IEEE Transactions on Power Systems, vol. 13, no. 1, pp.217-225, 1998.

[12]. Ho, K.L., Hsu, Y.Y., Chen, C.F., Lee, T.E., Liang, C.C., Lai, T.S. and Chen, K.K., "Short term load forecasting of Taiwan power system using a knowledge-based expert system". IEEE Transactions on Power Systems, vol. 5, no. 4, pp.1214-1221, 1990.

[13]. Rahman, S. and Hazim, O., "Load forecasting for multiple sites: development of an expert system-based technique". Electric Power Systems Research, vol. 39, no. 3, pp.161-169, 1996.

[14]. Çevik, H.H. and Çunkas, M., "A fuzzy logic based short term load forecast for the holidays". International Journal of Machine Learning and Computing, vol. 6, no. 1, pp.57, 2016.

[15]. Jain, Amit, E. Srinivas, and RasmimayeeRauta. "Short term load forecasting using fuzzy adaptive inference and similarity". In Nature & Biologically Inspired Computing, 2009. NaBIC 2009. pp.1743-1748. IEEE, 2009.

[16].Çevik, H.H. and Çunkaş, M., "Short-term load forecasting using fuzzy logic and ANFIS". Neural Computing and Applications, vol. 26, no. 6, pp.1355-136, 2015.

[17].Ranaweera, D. K., N. F. Hubele, and G. G. Karady. "Fuzzy logic for short term load forecasting". International Journal of electrical power & energy systems, vol. 18, no. 4, pp.215-222, 1996.

[18].Khotanzad, A., Afkhami-Rohani, R., Lu, T.L., Abaye, A., Davis, M. and Maratukulam, D.J., "ANNSTLF-a neural-network-based electric load forecasting system". IEEE Transactions on Neural networks, vol. 8, no. 4, pp.835-846 1997.

[19].Tayeb, EisaBashier M., A. Taifour Ali, and Ahmed A. Emam. "Electrical Energy Management and Load Forecasting in a Smart Grid". 2013.

[20].Khotanzad, A., Afkhami-Rohani, R. and Maratukulam, D., "ANNSTLF-artificial neural network short-term load forecaster-generation three". IEEE Transactions on Power Systems, vol. 13, no. 4, pp.1413-1422, 1998.

[21].Chow, T.W.S. and Leung, C.T., "Nonlinear autoregressive integrated neural network model for short-term load forecasting". IEE Proceedings-Generation, Transmission and Distribution, vol. 143, no. 5, pp.500-506, 1996.

[22].Mohammed, O., Park, D., Merchant, R., Dinh, T., Tong, C., Azeem, A., Farah, J. and Drake, C., "Practical experiences with an adaptive neural network short-term load forecasting system". IEEE Transactions on Power Systems, vol. 10, no. 1, pp.254-265, 1995.

[23].Park, D.C., El-Sharkawi, M.A., Marks, R.J., Atlas, L.E. and Damborg, M.J., "Electric load forecasting using an artificial neural network". IEEE Transactions on Power Systems, vol. 6, no. 2, pp.442-449, 1991.

[24].Raza, M.Q., Nadarajah, M., Hung, D.Q. and Baharudin, Z., "An intelligent hybrid short-term load forecasting model for smart power grids". Sustainable Cities and Society, vol. 31, pp.264-275, 2017.

[25].Dillon, T.S., Sestito, S. and Leung, S., "Short term load forecasting using an adaptive neural network". International Journal of Electrical Power & Energy Systems, vol. 13, no. 4, pp.186-192, 1991.

[26].Lee, K.Y., Cha, Y.T. and Park, J.H., "Short-term load forecasting using an artificial neural network". IEEE Transactions on Power Systems, vol. 7, no. 1, pp.124-132, 1992.

[27].Lu, C.N., Wu, H.T. and Vemuri, S., "Neural network based short term load forecasting". IEEE Transactions on Power Systems, vol. 8, no. 1, pp.336-342, 1993.

[28].Ho, K.L., Hsu, Y.Y. and Yang, C.C., "Short term load forecasting using a multilayer neural network with an adaptive learning algorithm". IEEE Transactions on Power Systems, vol. 7, no. 1, pp.141-149, 1992.

[29].Daneshdoost, M., Lotfalian, M., Bumroonggit, G. and Ngoy, J.P., "Neural network with fuzzy set-based classification for short-term load forecasting". IEEE Transactions on power systems, vol. 13, no. 4, pp.1386-1391, 1998.

[30].Hsu, Yuan-Yih, and Chien-Chuen Yang. "Design of artificial neural networks for short-term load forecasting. Part 1: Self-organizing feature maps for day type identification". In IEE Proceedings C (Generation, Transmission and Distribution), vol. 138, no. 5, pp. 407-413. IET Digital Library, 1991.

[31].Kothari, D. P., &Nagrath, I. J. "Modern power system analysis". Tata McGraw-Hill Education, 2011.

[32].Hippert, Henrique Steinherz, Carlos Eduardo Pedreira, and Reinaldo Castro Souza. "Neural networks for short-term load forecasting: A review and evaluation". IEEE Transactions on power systems, vol. 16, no. 1, pp.44-55, 2001.

[33].Engle, Robert F., Chowdhury Mustafa, and John Rice. "Modelling peak electricity demand".

Journal of forecasting, vol. 11, no. 3, pp.241-251, 1992.

[34].Peng, T. M., N. F. Hubele, and G. G. Karady. "Advancement in the application of neural networks for short-term load forecasting". IEEE Transactions on Power Systems, vol. 7, no. 1, pp.250-257, 1992.

[35].Vapnik VN. "The nature of statistical learning theory"; Jordan M, Lauritzen SL, Lawless JL, Nair V, editors.

[36].Saxena, D., Singh, S. N., & Verma, K. S. "Application of computational intelligence in emerging power systems". International Journal of Engineering, Science and Technology, vol. 2, no. 3, pp. 1-7, 2010.

[37].Keyhani, A., "Design of smart power grid renewable energy systems". John Wiley & Sons, 2016.

[38].Zurada, Jacek M. "Introduction to artificial neural systems". vol. 8. St. Paul: West, 1992.

[39].Rajasekaran, S., & Vijayslakshmi, P. G. A., Neural networks, fuzzy logic and genetic algorithms, PHI Learning Private Ltd, 2011.

[40].Olagoke, Mahrufat & Ayeni, A & Hambali, Moshood, "Short Term Electric Load Forecasting using Neural Network and Genetic Algorithm", International Journal of Applied Information Systems (IJAIS), Vol. 10, pp. 22 – 28, doi: 10.5120/ijais2016451490.

Cite this article as :

Suraj G. Patil, Dr. M. S. Ali, "Review on Analysis of Power Supply and Demand in Maharashtra State for Load Forecasting Using ANN", International Journal of Scientific Research in Science and Technology (IJSRST), Online ISSN : 2395-602X, Print ISSN : 2395-6011, Volume 9 Issue 1, pp. 341-347, January-February 2022. Available at doi : https://doi.org/10.32628/IJSRST229152

Journal URL : https://ijsrst.com/IJSRST229152