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LOAD FORECASTING USING FUZZY LOGIC

Sagar R. Kamble[1], Samadhan D. Deokar[2], Sumit M. Latke[3], Manik M. Hapse[4]

[1,2,3]B. E. Student, Dept. of Electrical Eng, S. B. Patil College of Engineering, Maharashtra, India
[4]Assistant Professor, Dept. of Electrical Eng, S. B. Patil College of Engineering, Maharashtra, India

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Abstract – *Load forecasting is an important component for power system energy management system. Precise load forecasting helps the electric utility to make unit commitment decisions, reduces spinning reserve capacity and schedule device maintenance plan properly. It also reduces the generation cost and increases reliability of power systems. In this work, a fuzzy logic approach for short term load forecasting is attempted. Time, temperature and similar previous day load are used as the independent variables for short term load forecasting. Based on the time, temperature and similar previous day load, fuzzy rule base are prepared using Mamdani implication, which are eventually used for the short term load forecasting. MATLAB SIMULINK software is used here in this work for system designing and simulation. For the short term load forecasting, load data from the 132kv sub-station, Indapur (load control center) is considered.*

Key Words: **Load Forecasting, Matlab, Fuzzy Logic, energy, etc.**

1. INTRODUCTION

Electrical load forecasting is very important for utilities and power system operators to meet the load plus the energy lost in power systems. Therefore, many operating decisions such as economic allocation of generation, security analysis and maintenance planning are based on load forecasts.[1] The load forecasts are typically programmed from a few minutes to an hour ahead or as much as 20 years into the future. Electrical load forecasting is divided into four types: long term, medium term, short term and very short term. The short-term load forecasting is a prediction of load from 1 hour to 1 week.

In this paper, the problem of load forecasting is constrained to short term load forecasting and is expressed as fuzzy linear estimation problem. Different membership functions, for load parameters are used namely triangular membership and trapezoidal functions. The main objective is to minimize the error between the actual load value and forecasted value of the available data points. Short term load forecasting is an integral part of power system operation and is used to predict load demand up to a week ahead so that day to day operation of a power system can be efficiently planned and the operating cost can be minimized.[2] Though Load forecasting is not an easy task to perform. The load on buyer side is complex. Also there are numerous significant externally affecting variables that should be taken into account such as weather, time economic situation and random disturbance.

The prime duty of any utility is to provide reliable power to customers. Customer load demand in electric distribution systems is subject to change because human activities follow daily, weekly, and monthly cycles.[3] The estimation of future active loads at various load buses ahead of actual load occurrence is known as load forecasting. If it is done inappropriately, then the direct effect is on the planning for the future load. Also the result is the difference of the load that will develop from the planning done for the same, and eventually the entire planning process is at risk. As the utility supply and consumer demand is fluctuating and the change in weather conditions, energy prices increases by a factor of ten or more during peak load, load forecasting is vitally important for utilities.

In this study MATLAB program is used for load forecast using fuzzy logic. A formulation of Fuzzy Logic System (FLS) used to construct nonparametric models of nonlinear processes, given only input– output data.

Load forecasting has been an integral part in the efficient planning, operation and maintenance of a power system .Short term load forecasting is necessary for the control and scheduling operations of a power system and also acts the power analysis functions such as load flow and contingency analysis. Owing to this importance, various methods have been reported, that includes linear regression ,exponential smoothing, stochastic process, ARMA models ,and data mining models. Of late, artificial neural networks have been widely employed for .However, there exist large forecast errors using ANN when there are rapid fluctuations in load and temperatures.

In , forecasting methods using fuzzy logic approach have been employed. In this paper, an approach for long term load forecasting problem, using fuzzy logic combined with ANN approach is proposed. The fuzzy logic technique has been used to classify the data's. The neural network is used to calculate the increment factor.

2. METHODOLOGY

The significance of this search is present short term load forecasting for a day ahead by taking into considerations time and weather parameters such as temperature. The classification of the load data is done using

fuzzy set techniques. Figure -1 shows the basic block diagram of the proposed work. The inputs to the fuzzy set based classifier i.e. hourly data of forecasted temperature and time are given to the fuzzy inference system through fuzzification block. The fuzzy inference block is the heart of the system as it processes the input data and gives output as the forecasted load.

2.1 Block Diagram

Block diagram of the proposed system is shown in the Fig -1. The system will work properly if all the subsystems works without any error.

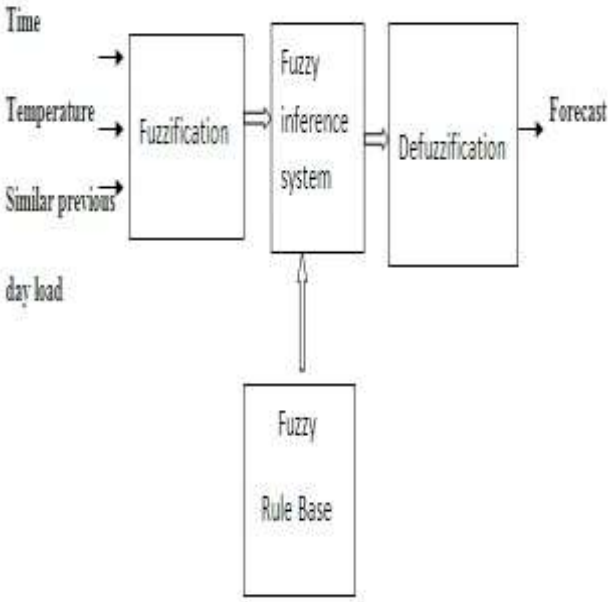

Fig -1: Block Diagram

The inference system accomplishes the task of forecasting by the used of the fuzzy rule based prepared by the forecaster. The accuracy of the forecast depends on the experience of the forecaster, the rules prepared by the forecaster and the number of rules prepared. After, the inference system gives output; the defuzzification block converts the fuzzified output to the crisp output which can be further displayed on a graph known as the load curve. Firstly, the historical data are examined and the maximum and the minimum range of different parameters are obtained.

2.2 Flow Chart

Flow chart of STLF using fuzzy logic. The output obtained is compared with the actual load and the error in load forecasting is used to improve the rule base for future forecast. This improvement in rule of fuzzy logic increases the accuracy of the load forecasting.

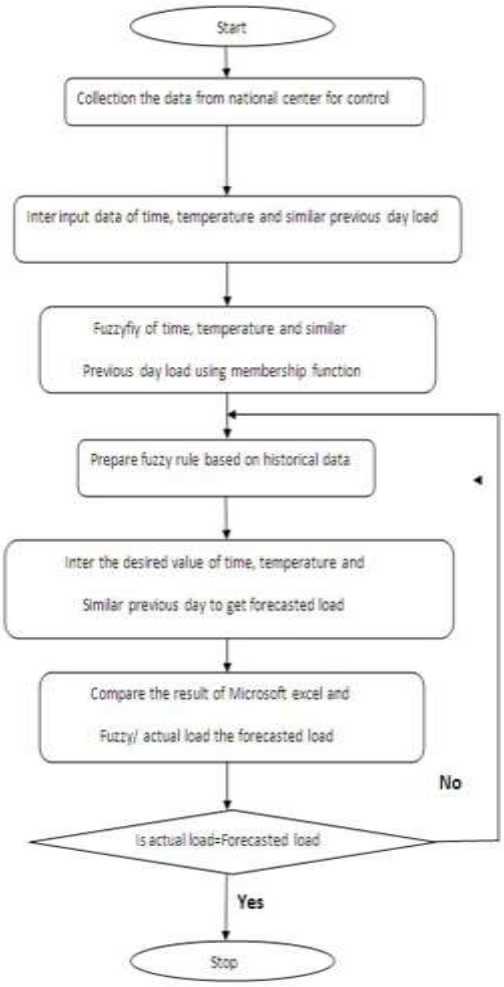

Fig -2: Flow Chart

These ranges are used in the process of the Fuzzification of different parameters such as time and temperature. After the fuzzification is done, based on the different parameter of load forecasting rule are prepared. This rules are the heart of the fuzzy system, so utmost care should be taken to prepare these rules. Once, the rules are prepared forecast the load of the desired hour.

2.3 Results

There are number of membership functions have been proposed in the past few year's namely triangular membership functions and trapezoidal membership functions. A more exact fuzzy expert system is acquired by separating the region into intervals. The intervals for the time have been divided into eight membership functions and intervals of temperature have been divided into four triangular membership functions.

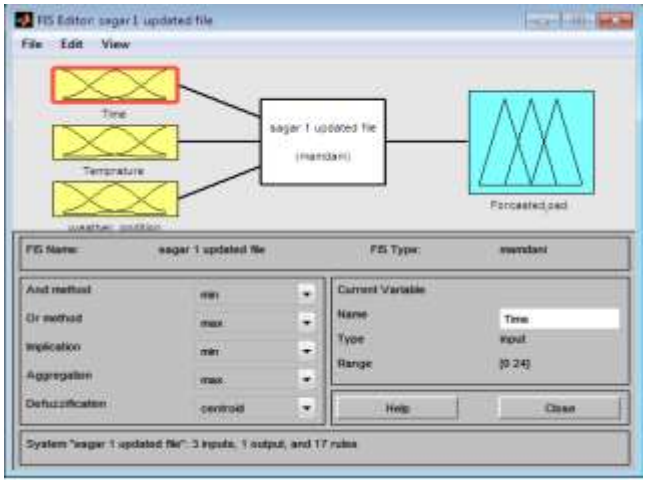

Fig -3: Fuzzy Membership functions.

According to our input variables we have take time from all days of week. The load is varies with respect to temperature and weather conditions. The results is shown in Fig- 4.In temperature membership functions are plotted between very low-low-medium-medium to high-high-very high. Range of this variable is [5 - 50] in centigrade.

According to our input variables we have variable as season viz. winter& fall, spring, summer, rainy, winter. This season our load becomes vary. The results are shown in Fig -5 In season membership functions are also plotted between winter& fall -spring- summer-rainy- winter. Range of this variable is [1 365].

The forecasting values are on the base of fuzzy relationship synthesize rules and input variables membership functions. The results are shown in Fig -6. The rules take a role to link input variables with output variables.

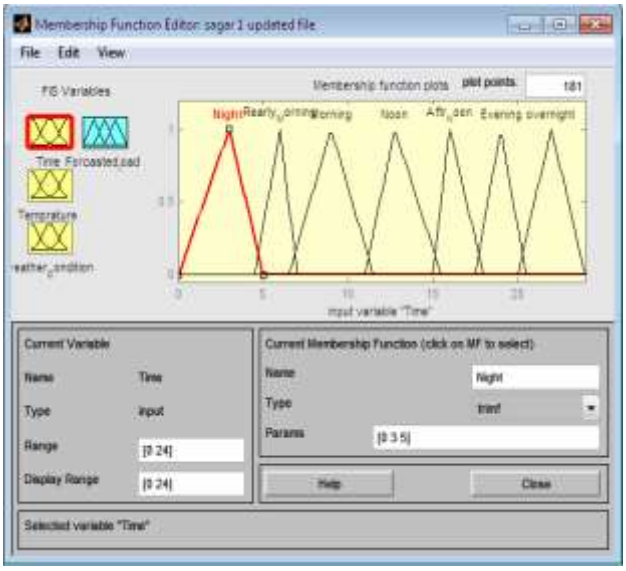

Fig -4: Time variables.

Result for Temperature variables is shown in the Fig -5.

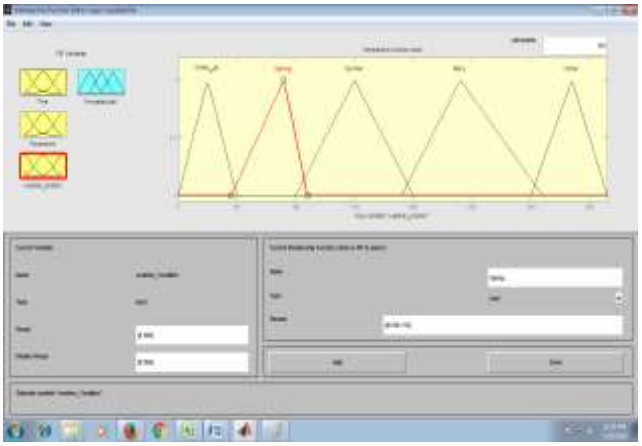

Fig -4: Temperature variables.

Results for weather condition variables is shown in Fig -6.

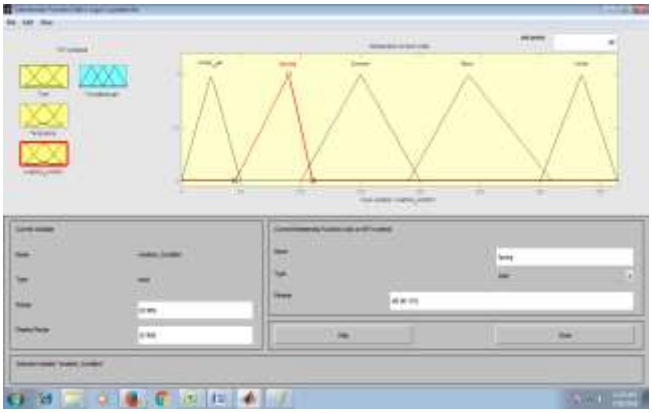

Fig -5: Real time value of temperature.

3. CONCLUSIONS

The important characteristic of the proposed methodology is the expansion of fuzzy logic approach to solve the forecasting problem with ambiguity of data such as temperature day types and load pattern etc. In this thesis the study shows that the fuzzy approach gives the better forecasting performance but it has easy process to deal with forecasting. In this project we calculated error between actual load and forecasted load ,this error due to some reasons like losses in power system, failure of machine due to ageing ,voltage and frequency instability, change in weather condition ,change in temperature…etc.

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