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Short Term Load Forecasting for Simillar Day Using Fuzzy Logic And Artificial Neural Network

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Abstract

Now a day, the load side demands varies continuously with time. So, it is required to forecasting the load to provide a reliable power demand to the load. Different short term forecasting methods are available. In this paper, fuzzy logic method is used. In, short term load forecasting by fuzzy method, hourly loads, day times, humidity, temperature etc. data are used. Along with these the past time data for same periods are used. So, these inputs are used to prepare a fuzzy logic. This fuzzy logic to be used to made for short term forecasting. The proposed method with fuzzy logic controller is described here.

Keywords*-Load forecasting, Fuzzy logic, Artificial neural network, STLF*

I.INTRODUCTION

Now a day, the load side demand varies continuously with time. So it is required to forecasting the load to provide a reliable power demand to the load.
In short term load forecasting (STLF) by fuzzy method, hourly loads, day times, humidity, temperature etc. data are used. Along with these the past time data for same periods are used.
In STLF, the future load on a power system is predicted by extrapolating a predetermined relationship between load and its influential variables. A prerequisite to the development of an accurate load forecasting model is an in-depth understanding of characteristics of the load to be modelled.

II.FUZZY LOGIC

This section presents general information about the theory of fuzzy logic. Definition of a fuzzy set and linguistic variable conception are presented. The meaning of a fuzzy rule is explained and some rule examples are given. Fuzzy reasoning mechanism and fuzzy inference systems are also presented.
A fuzzy set, as the name implies, is a set without a crisp boundary. That is, the transition from "belong to a set" to "not belong to a set" is gradual, and this smooth transition is characterized by membership functions that give fuzzy sets flexibility in modelling commonly used linguistic expressions

The fuzzy system is a popular computing framework based on the concepts of 'fuzzy set theory', 'fuzzy if then rules' and 'fuzzy reasoning'. The structure of fuzzy inference consists of three conceptual components, namely:

1. Rule Base containing a selection of fuzzy rules.

2. Database defining the membership functions. These are used in the fuzzy rules.

3. Reasoning mechanism that performs the inference procedure upon the rules and given factor and derives a reasonable output or conclusion.

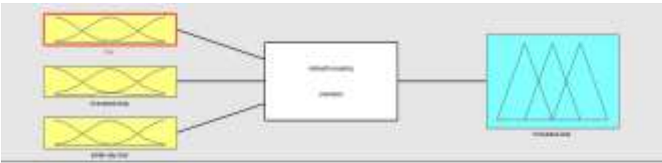

Fig 2.1 inputs and output of fuzzy logic

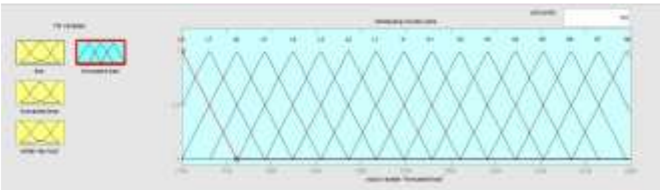

Fig 2.2 Membership function of fuzzy logic

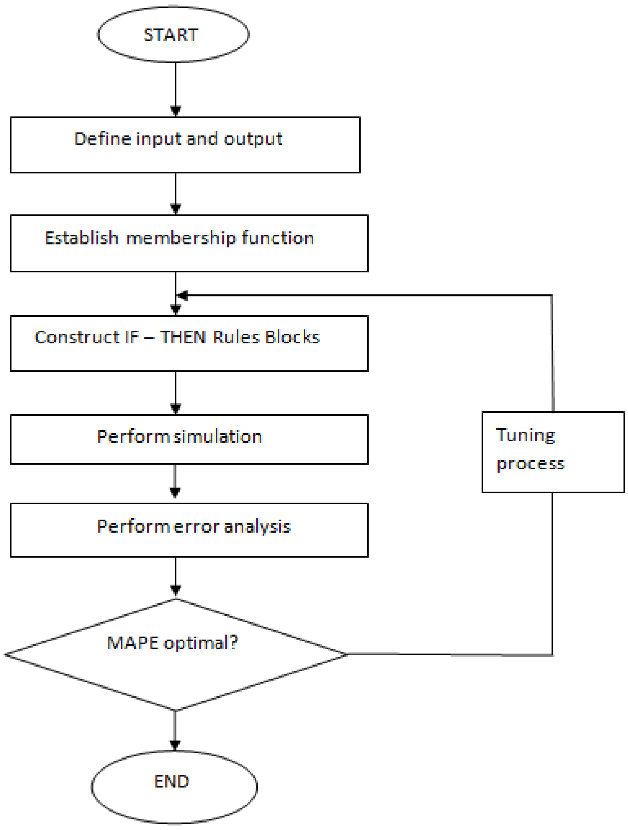

Fig 2.3 Flow chart of fuzzy logic

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I. STLF USING ANN

A Neural network is an artificial representation of the human brain that tries to simulate the learning process. The brain is a highly complex, nonlinear and parallel information processing system. It has the capability to organize its structural constituents, known as neurons, so as to perform certain computations many times faster than the fastest digital computer in existence today.

The basic building block of an artificial neural network is the neuron. The basic structure of an artificial neuron is shown in Fig3.1. In a popular model, the connection weights between neurons are adjusted. The neuron receives inputs O_{pj} from neuron ui while the network is exposed to input pattern p. Each input is multiplied by a connection weight w_{ij}, where w_{ij} is the connection between neurons ui and uj. The connection weights correspond to the strength of the influence of each of the preceding neurons. After the inputs have been multiplied by the connection weights for input pattern p, their values are summed, net_{pj}. Included in the summation is a bias value θ_j to offset the basic level of the input to the activation function, $f(net_{pj})$, which gives the output O_{pj}.

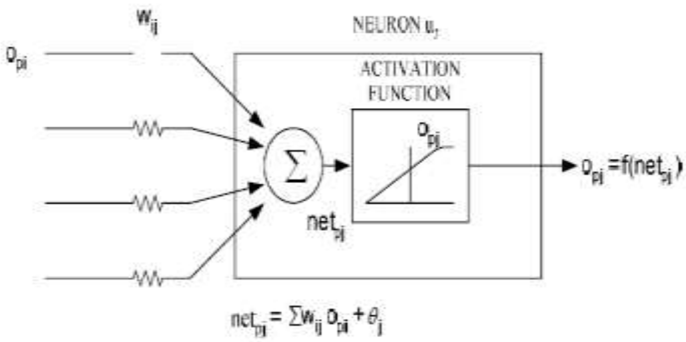

Fig 3.1 Artificial Neuron

In order to establish a bias value θ_j, the bias term can appear as an input from a separate neuron with a fixed value (a value of +1 is common). Each neuron requiring a bias value will be connected to the same bias neuron. The bias values are then self-adjusted as the other neurons learn, without the need for extra considerations.

In calculating the output of the neuron, the activation function may be in the form of a threshold function, in which the output of the neuron is +1 if a threshold level is reached and 0 otherwise. The various activation functions like squashing, hyperbolic tangent, sigmoid etc. can be used. Squashing functions limit the linear output between a maximum and minimum value. Hyperbolic tangents and the sigmoid functions are similar to real neural responses; however, the hyperbolic tangent is unbounded and hard to implement in hardware.

The artificial neural network is made up of several components. These components are summarized as:-

Weighting Factors: *A neuron usually receives many simultaneous inputs. Each input has its own relative weight which gives the input impact that it needs on the processing element's summation function. These weights perform the same type of function as do the varying synaptic strengths of biological neurons. In both cases, some inputs are made more important than others so that they have a greater effect on the processing element as they combine to produce a neural response. These strengths can be modified in response to various training sets and according to a network's specific topology or through its learning rules.*

Summation Function: *The first step in a processing element's operation is to compute the weighted sum of all of the inputs. Mathematically, the inputs and the corresponding weights can be represented as O_{pi} and w_{ij} respectively. The total input signal to the next layer neuron is the dot or inner product of these two vectors. This simplistic summation function is found by multiplying each component of the input by the corresponding component of the w_{ij} array and then adding up all the products. So, the input to the neuron of next layer is a single number, not a multi-element array.*

Activation Function: *Activation function in the ANN maps the input(s) to the output(s). Hence, it is an important element of the network for a successful network design. It is the key element to invoke the nonlinear relationship between the input and the output. Without the transfer function the whole operation is linear and could be solved using linear algebra or similar methods. To simplify the whole neuronal*

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operation, first we produce the weighted sum of the input values which acts like a single lumped input value for the whole input data. And then we apply the transfer function on this lumped input value.

In an artificial neural network first and foremost is the preparation of training data. Training data are prepared on the bases of the previous load data available, the forecasted temperature. The training data for the month of May, 2014 are prepared based on the load data available from Area Load Dispatch Centre, UGVCL, Gandhinagar. After the preparation of training data neural network is created using fitting tool. In the creation of neural network number of inputs, number of hidden layer neurons and number of outputs are selected. Once this is done, the network is trained using training data prepared. Now, the neural network is ready for the short term load forecasting. The input data of the day to be forecasted is given to the neural network, also the uncertainties such as any permanent or emergency shutdown of substation or any line outage or insertion is considered.

IV.SIMULATION AND RESULT

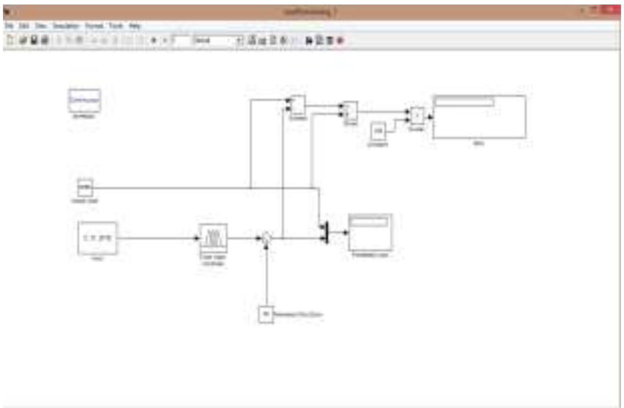

Fig. 4.1 Simulation of STLF using Fuzzy logic on 8-5-14

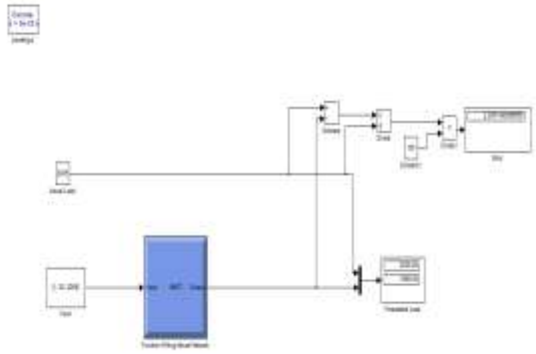

Fig. 4.2 Simulation of STLF using ANN on 8-5-14

Table 4.1Comparison of fuzzy and ANN on 8-5-14

Time (Hrs.)	*Previous Similar Day Load (MW)*	*Actual Load (MW)*	*Fuzzy Forecasted Load (MW)*	*ANN Forecasted Load (MW)*
1	*2058*	*2035*	*2050.125542*	*1989.550253*
2	*2013*	*2006*	*2012.733328*	*1986.255713*
3	*1983*	*1989*	*1982.403918*	*1973.299935*
4	*1963*	*1938*	*1963.110991*	*1946.638584*
5	*1933*	*1935*	*1932.607991*	*1909.486583*
6	*1959*	*1942*	*1946.506912*	*1912.535089*
7	*1902*	*1900*	*1901.860949*	*1890.829591*
8	*1854*	*1888*	*1855.387763*	*1882.935315*
9	*2018*	*2013*	*2018.241086*	*2015.565047*
10	*2077*	*2050*	*2075.225441*	*2091.123968*
11	*2104*	*2094*	*2088.689472*	*2110.800916*
12	*2131*	*2076*	*2106.621956*	*2120.251585*

V.CONCLUSION

Fuzzy logic is used to evaluate the correction factor of the selected similar days to the forecast day using the information of the previous forecast day and the previous similar days.The error in the forecasting the load can even be lowered if a large and accurate training data is used.

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