A Comprehensive Study of Daily Load Forecasting Using Temperature Match

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***Abstract*— Load forecasting is a central and integral process in the planning and operation of electric utilities. It involves the accurate prediction of electric load over the different periods of the planning horizon. Also accurate load forecasting holds a great saving potential for electric utility corporations. A model for hourly load forecasting based on temperature match is discussed in this paper. A day in historic database which matches forecasting day in temperature is found. A programming model is developed for this purpose. Hourly load of that day is used to predict the load of forecasting day. Also the past loads are observed to follow two distinct patterns: peak hours and off peak hours, in other words demand in case of former is more as compared to the latter. This phenomena is taken into account while predicting the load for any day. Besides, the DLC effect on system load is also considered. Also an optimal error reduction technique concept is used in this method which helps that the forecasts to be resulted with high accuracy.**

***Keywords*— include at least 5 keywords or phrases**

I. INTRODUCTION

Load forecasting is extremely important in electric energy generation, transmission, distribution and markets. The purpose of load forecasting is proper planning. And operation of power utility requires an adequate model for electric power load forecasting. Load forecasting plays a key role in helping an electric utility to make important decisions on power market, load switching, voltage control, network reconfiguration, and infrastructure development .Three types of load forecasting are

- Long term load forecasting
- Medium term load forecasting
- Short term load forecasting

Long Term Load Forecasting:-Long term load forecasting is used for the long term power system planning according to the future energy demand and energy policy of the state. This is longer than a year.

Medium Term Load Forecasting:-Medium term load forecasting is used for the efficient operation and maintenance of the power system. This is usually from a week to a year.

Short Term Load Forecasting:-Short Term Load Forecasting is used to provide necessary information for the system management of day to day operations and unit commitment.

In this paper a short term load forecasting based on temperature match is done. A day in historic database which matches forecasting day in temperature is found. Hourly load of that day is used to predict the load of forecasting day.

In spite of existence of a good temperature match between the forecasting day and the base day, sometimes load predictions tend to differ from the actual load due to randomness in power consumption. To avoid this problem an algorithm is used which ensures that each hour load prediction error goes on decreasing. In other words error in the load prediction at first hour is noted and with the help of error reduction algorithm it is possible to reduce prediction errors at remaining hours. Thus prediction errors could be reduced efficiently and an accurate prediction for a day is possible.

II. LITERATURE SURVEY

III. ANALYSIS OF HISTORIC DATA

To make the future load forecasting using the temperature match technique, it is necessary to have a historic data base including both the past temperature and load data. For this purpose substation data of previous 4 years are collected and analysed.

III.1 SEASON SEPERATION

From the data collected it could be seen that as the temperature varies along with seasons the load demand of the substation also varies. In Fig.1 and Fig.2 it could be observed that the average Megawatt load of substation is around 20 MW in January and May. Whereas, the load is comparatively less in June as observed in Fig.3. These observations tend to say that there exists a season change from May to June. Similar season change is observed from October to November. Similar trends are shown by remaining past years as well.Hence the historic data base of 4 years is classified into three different seasons based on load demand.

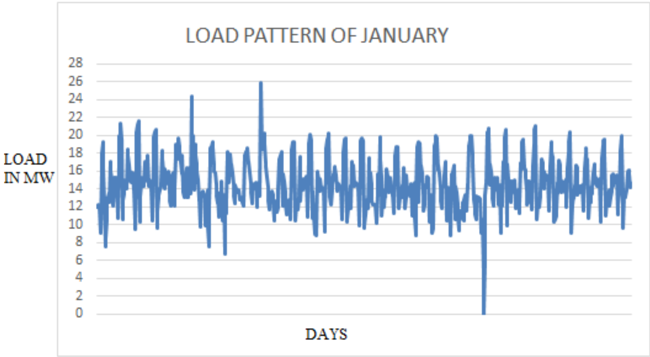


Fig. 1 Observation of load pattern of month January of 2009

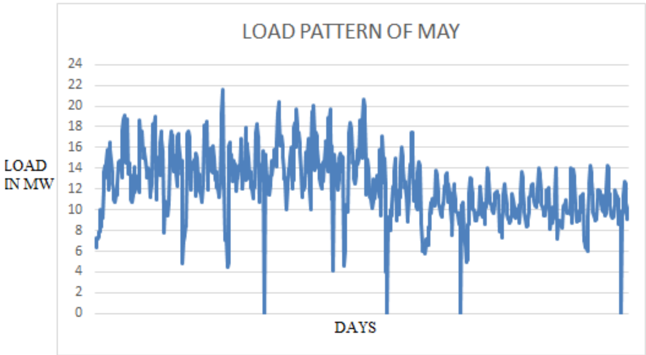


Fig. 2 Observation of load pattern of month MAY of 2009

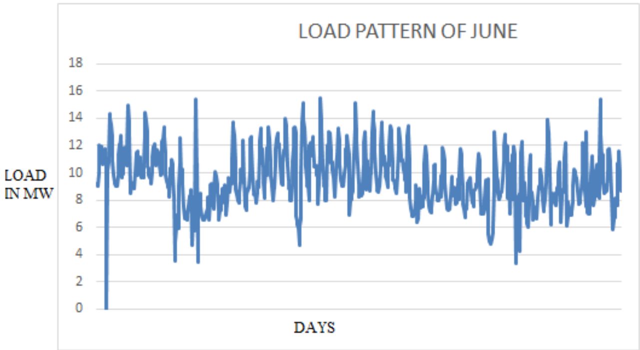


Fig. 3 Observation of load pattern of month JUNE of 2009

III.2 PEAK AND OFF PEAK HOURS

Similarly daily loads are observed to follow different patterns. Load consumption is more during the day time as compared to that during the night. Fig.4 depicts this character of the daily load. That is, load demand is higher between hour 8 to 21.This necessitates another classification of historic data base as peak and off peak hours.

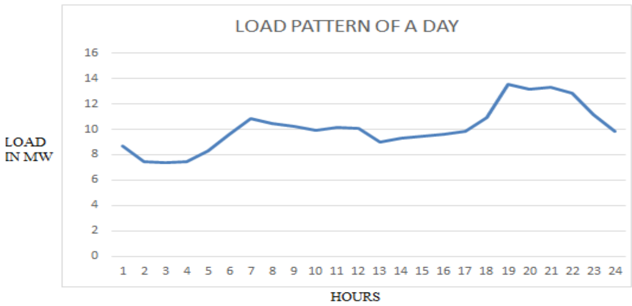


Fig. 4 Observation of load pattern of a day

Classifications above mentioned results in the historic data base being parted to six different groups of data. It is a fact that a forecasting day belonging to a particular group among these six shall have the base day (with maximum temperature match) in the same group.

IV. BASE DAY DETERMINATION

A base day would be that day in past which has the minimum weighted total matching error of the hourly temperatures of that day with the forecasting day.

This could be achieved as follows: Days belonging to the same season as that of forecasting day are considered. Overall load consumption in those days is calculated. Then a factor called normalized weight factor is to be found. This normalized weight factor is unique for a season and for each hour. This means, say, for hour 1 the normalized weight factor is the total load only hour 1 in that season as compared to the overall load in that season. In each season one group of factors can be estimated for peak hours and another group for off peak hours.

Square of hourly temperature differences between the forecasting day and a day in past when multiplied with corresponding normalized weight factors it results in matching errors. When they are added over a day it gives weighted total matching error for that day. This is calculated for all the days belonging to that season .and whichever day has the minimum value is the base day to be considered for that forecasting day. And the corresponding year is considered as base year.

V. ERROR REDUCTION

Certain number of days in the forecasting year before the day when the actual load forecasting is and same set of days in the base year are considered. And the load growth factor which defines how greater the forecasting year's loads as compared to base year is found.

Load of the base day is multiplied by this growth factor and projected as the predicted load for the forecasting day. This prediction which can be considered as first set of prediction is likely to be far from the actual load of the forecasting day as shown in fig.5. Thus the next step is to reduce the errors in this prediction.

Information of error at hour 1 in the first prediction helps to reduce the error at the remaining hours.

A detailed explanation of this technique is as follows:

This method needs estimation of error coefficients. To find these coefficients initially a certain number of days before the day when the actual load forecast required are considered. Loads of these days are compared with the first set of predictions and the hourly errors are noted down. Error coefficient for hour say 2 is the sum of all errors at hour 2 divided by the errors at hour 1. This coefficient is used to reduce the error at hour 2 similarly error coefficients are found for each hours of the day and predictions becomes better. This results in second set of predictions which is more accurate than the previous predictions as depicted in Fig.6.

Still there is a possibility of minute errors. This could be reduced by finding error coefficients again and modifying the predictions which will be the third set of predictions. This process is continued till the error is minimum.

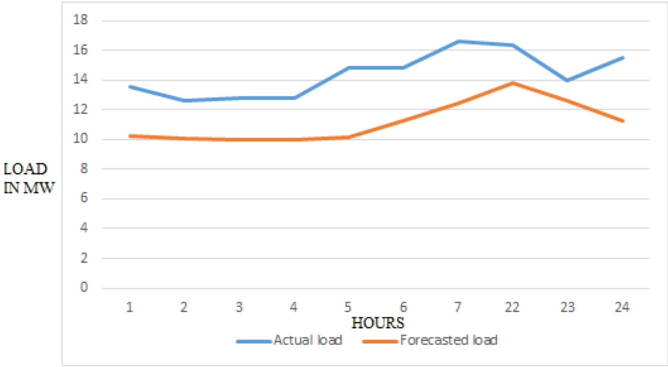


Fig. 5 Comparison of actual load with the initial set of predictions

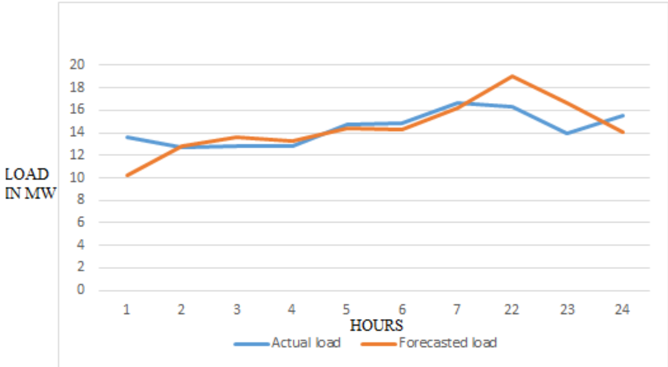


Fig. 7 Comparison of actual load with the second set of predictions

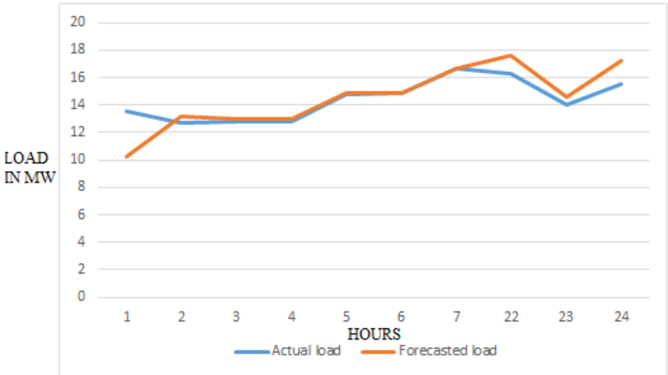


Fig. 7 Comparison of actual load with the final predictions

VI. LITERATUR SURVEY

Zuwei Yu, School of Engineering University of Oklahoma.

1. OTM method can make better than BOX-Jenkins method, but not better than BJTF which takes account of weather and temperature.

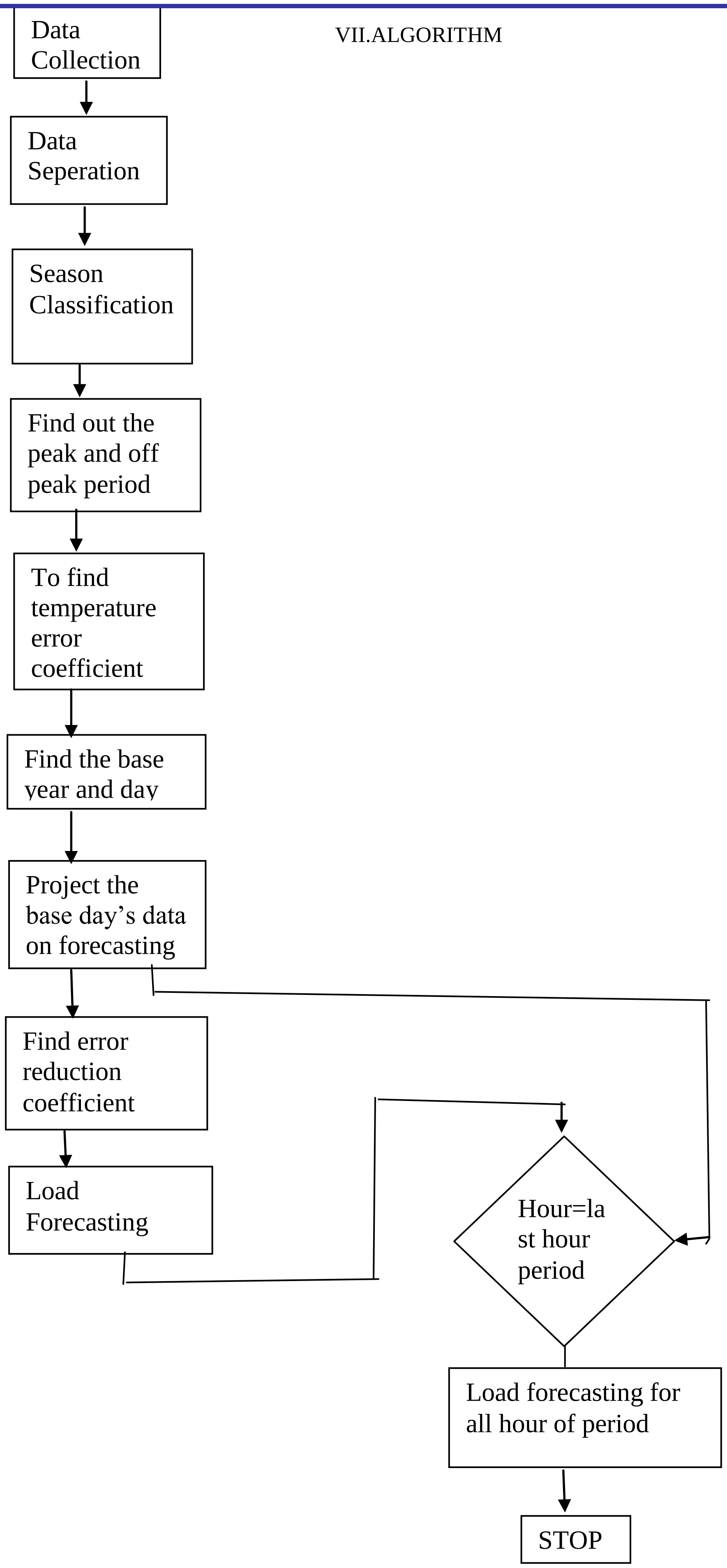
Following this paper

1. Historical datas of temperature and load are collected.
2. Seasons are classified based on the loads.
3. Optimal temperature matching modal is built for minimising weighted total matching error of hourly prediction.
4. Base year and base day is found on considering the least temperature error value.
5. Error reduction factor is found to minimise the load prediction errors from hour 2 to hour 24

Going off path from the paper, the differentiation between the peak off period and peak period helps in the determination of patterned load prediction, considering off peak period as night and peak period as the day and merging both the periods as a day to get 24 hour load prediction.

The OTM method can produce accurate method than RMS since OTM doesn’t consider humidity information.It can give accurate results than BJTF method.Disadvantage is that it requires larger data base than the other methods.

VII.ALGORITHM



VIII CONCLUSION

This paper introduces an optimal template temperature match method for short term load forecasting. The basic method is supplemented by a technique for reducing the forecast errors utilizing the error reduction procedure after the basic forecasts have been made. The error reduction technique is an effective concept in load forecasting and is the key to the success of the OTM method in daily load forecasting.

IX. FUTURE WORK

Matlab simulation of the OTM model

X .REFERENCES

[1] Zuwei Yu, A Temperature Match Based Optimization Method For Daily Load Prediction Considering DLC Effect,IEEE Transactions on Power Systems, Vol. 11, No. 2, May 1996.
[2] D.C. Park, et al, "Electric Load Forecasting Using an Artificial Neural Network," IEEE 90 Summer meeting, paper 90 SM 377-2 PWRS.
[3] S.M. Ahmed, A.M. Breipohl, F.N. Lee, and D. Zhai, "Short Term Load Forecasting Using Artificial Neural Networks," Research report for Public Service Company, OU-PSOTR-90-01, 1990.