Electricity load profile prediction using Regression Tree, ANN and FCNN

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Abstract - *For best utilization of electricity, power load prediction plays a significant role in energy management. AN economical load prediction permits distributors for higher power commitment and schedule maintenance plans effective. Moreover, irresponsibleness of energy systems is additionally a lot of necessary than the step-down of generation and cost. It's been determined that the electric power needed may be a operate of climate conditions and community (residential space, workplace or industry). A statistic data processing approach is getting used to classify and cluster the realm in step with power consumption. To classify and cluster the implementation of a completely unique fuzzy neural network model on an hourly basis, and validates its performance on the basis of prediction of electricity power consumption of the facility system of the realm. A multiplication neural network has replaced the classic linear model that sometimes seems within the ensuing a part of a neuro fuzzy theme, whereas subtractive clump with the help of the Expectation– Maximization algorithmic program is being used within the definition of fuzzy rules. The results can relate to the minimum and most load exploitation metered information obtained from the facility system of the realm indicates*

Key Words: **Artificial Neural network, Data mining, Prediction, ANFIS, Regression, Time-series prediction**.

1. INTRODUCTION

Electricity has become a basic would like for the human race nowadays. it's accustomed perform a variety of day to day work, like in operation domestic and industrial equipments, lighting, heating, air-conditioning, cooking, laundry and lots of different tasks. we will visualize this truth of however it's become a basic would like for human race, by simply watching the planet at nighttimes, that illustrates the electricity needed to lightweight the planet at nighttimes. This can be true for the Norwegian community additionally, that illustrates the electricity consumption among totally different user teams from 1990 to 2007. This indicates a rise in consumption for several user teams over the years. So it's clear that electricity has become a very important artifact for the individuals. Prediction of electricity consumption is important to manage the facility system effectively and thereby full this increasing demand. On a long basis, power firms would need the facility

Consumption forecast within the next ten or twenty years to arrange their future activities properly, like building adequate power plants and improve their transmission and distribution networks to satisfy the mandatory demand. On a short basis, prediction is needed to perform daily operations like unit commitment, energy transfer programming and cargo dispatch of a utility company. Therefore, correct prediction of electricity consumption is crucial for each, playacting daily operations and creating future power plans for an influence provision company. Electricity prediction is done principally in 3 ways, as short, medium-term and long. short prediction refers to AN hour to every week prediction, whereas medium-term considers the vary between every week and a year, and predictions that run over a year area unit thought of as long forecasts. Within the literature, we will observe numerous freelance variables (predictors), that influence the consumption, are used for prediction underneath these 3 schemes, particularly for short- term and Long.

The agencies who give out electricity from the concluding phase of the process are keen to offer better and continuous

supply to their consumers all the time. In this process, they have to control and monitor the distribution of electricity through their power systems according to the requirement from the consumers. Energy enters the power consumption in the region on an hourly base.

II. BACKGROUND, SUPPLYING PROCESS AND CONSUMPTION

A. Background

Forecasting of electricity consumption is necessary to manage the power system effectively and thereby fulfil this increasing demand. On a long term basis, power companies would require the power consumption forecast in the next 10 or 20 years to plan their future activities properly, such as building adequate power plants and improve their transmission and distribution networks to meet the necessary demand. on short –term basis ,forecasting is required to perform daily operation such as unit commitment, energy transfer scheduling and load dispatch of utility company. Therefore, accurate prediction of electricity consumption is crucial for both, performing daily operation and making future power plans for a power supplying company.

B. Electricity supplying process

There is a complex process associated with delivering electricity safely and reliably to households and industries. This operation takes three basic stages: generation, transmission and dispersion. The base of power generation is the power plant, which includes turbines and generators. There are dissimilar cases of power plants based on the source of energy, such as hydro power, thermal, wind, solar and so along. In the following phase, three-phase power generated by this power plant is transmitted to a long distance through high voltage transmission cables as indicated in the image. Before sending, the voltage of the generated force is increased (step-up) by the transformers in the transmission substation. These transmission lines are then linked to power substations where the high voltage power is stepped down to a degree that can be broadcast across a certain neighborhood. This tone is the terminal level of the power system which is as well known as the distribution point. From the distribution transformer, the distribution bus line carries electricity to the households and industries. In short-term electricity forecasting, the main focus goes to the distribution point. This is because; the

controlling process could be only carried out at this stage by allocating proper resources on a short-run base.

C. Electricity consumption

The agencies who give out electricity from the concluding phase of the process are keen to offer better and continuous supply to their consumers all the time. In this process, they have to control and monitor the distribution of electricity through their power systems according to the requirement from the consumers. Energy enters the power consumption in the region on an hourly base. In summation to the power consumption, the forecast temperature, actual temperature, wind speed and cloud cover are also evaluated with the use. These measurements, which we plant in the dataset, are the foundation for the forecasting carried out in this

III. DATA SET

Our data set comprises aggregate for 24 hours for an area, measured for a period of different years. The measured values are stored temporarily and upload daily to our data collection server. We record ambient air temperature value published on a weather station and holiday list are provide by internet.

IV.LITERATURE REVIEW

Electricity power prediction plays vital role for the development of smart grid, and hence we can plan distribution according to predicted power requirement. Prediction is a Data mining approach and it is beneficial for power companies to plan production in long term accordingly. It is a probabilistic approach any sudden change in environment (earthquake, heavy rain, strikes etc) can deviate the result from predicted value.

V.PREDICTION MODEL

A. Artificial Neural Network

Artificial neural network have been used for forecasting electricity consumption .The concept of ANN arises from the knowledge of the biological nervous system. The nervous system is constructed by a number of structural constituents known as neurons, which are connected to each other by links. This network of neuron connected through links, is referred to as a neural network-

A neuron is defined by Patterson as follows:

A neuron is a small cell that receives electrochemical stimuli from multiple sources and responds by generating electrical impulses that are transmitted to other neurons of effecter cells.

The input side is the one which is named as dendrites in the figure. Dendrites are connecting the outputs from the other neurons to this neuron through synapses. There are a number of various synaptic connections to the neuron from which it can receive input signals. The outputs are carried through the axon to other neurons (through dendrites) or directly to effecters organs such as muscles and glands.

B. Regression Tree

Regression analysis can be loosely defined as application of methods that investigate the relationship between a dependent (or response) variable and set of independent variable (or predictor) variables. Linear regression is a global model, where there is a single predictive formula holding over the entire data-space. When the data has lots of features which interact in complicated, nonlinear ways, assembling a single global model can be very difficult and hopelessly confusing when you do succeed. An alternative approach to nonlinear regression is to sub-divide, or partition, the space into smaller regions, where the interactions are more manageable. We then partition the sub-divisions again and this is called recursive partitioning. Until finally we get to chunks of the space which are so tame that we can fit simple models to them.

C. FCNN

The CNN is nonlinear regression structure that represents input-output mappings by dilated and translated versions of curvelet function. The translation parameter determines the centre position of the curvelet, whereas the dilation parameter controls the spread of the curvelet.

VI. DISCUSSION

A. Prediction Using Regression tree:

Regression Tree algorithm was written on MATLAB to predict the power consumption for next hour. For this the whole data for year 2004-08 is divided into two parts: Training Dataset: from 1st Jan 2004 to 31st Dec 2006 as training dataset and Test Datasets: from 1st Jan 2007 to 31st Dec 2008 as testing dataset
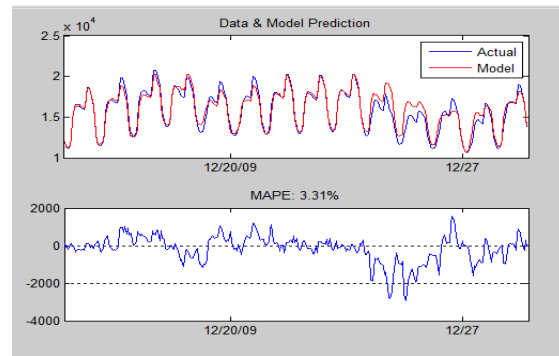

Fig-1 Data and Model prediction using Regression tree

B. Prediction Using ANN:

ANN algorithm was written on MATLAB to predict the power consumption for next hour. For this the whole data for year 2004-08 is divided into two parts: Training Dataset: from 1st Jan 2004 to 31st Dec 2006 as training dataset and Test Datasets: from 1st Jan 2007 to 31st Dec 2008 as testing dataset.
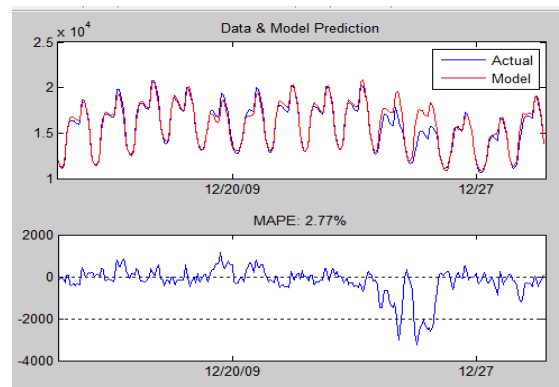

Fig-2 Data and Model prediction using ANN

C. Prediction Using FCNN:

The Mean square prediction result is minimum by using FCNN as compared to Regression tree as well as Artificial Neural Network. The Prediction model is trained for the selected data set. Our data is divided into two sets: Training set and Test set. The training data will be inputted to this Prediction model to compute the output weights. Once we are done with the training data, the network is ready for prediction.

The data is split into two set training set and test set the data from 2004 to 2007 is divided in training set which the 80% of all data. It is used for building the model (estimating the parameter). The data of 2008 is divided in test set which

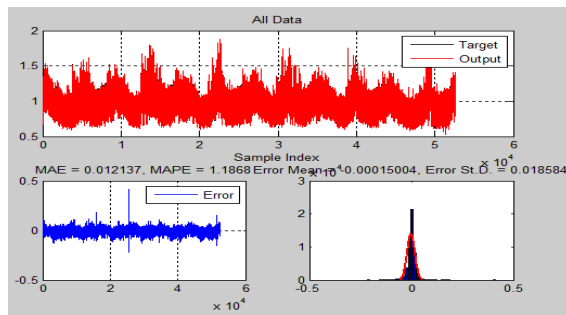20% of total data. It is used only for forecasting to test the performance of the model on out of sample.

Fig-3 Data and Model prediction using FCNN

VII. CONCLUSION

The Prediction model is trained for the selected data set. Our data set will be a chaotic time series of load 80% of this time series data will be used as training data and 20% time series data will be used as test data. The training data will be inputted to this Prediction model to compute the output weights. Once we are done with the training data, the network is ready for prediction. By using FCNN the Mean Absolute Percent Error (MAPE) and Mean Absolute Error is (MAE) is minimum as compare to the ANN and Regression tree. The final output of FCNN which is MAPE of 1.18% and MAE is 0.012 Mwh which is normalized value by multiplying the maximum power we calculate the original MAE. Almost 57 % error is reduced by using FCNN model.

The error is reducing once we increase the number of power difference variable in the feature which could be extended more in the future extension of the work.

In addition to that more feature space reduction and scaling methods could be tested to forecasting future electricity consumption

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