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USING ARTIFICIAL NEURAL NETWORK AND STATISTICAL APPROACH FOR TIME SERIES FORECASTING (BY USING CLUSTERING AND CLASSIFICATION ALGORITHMS)

I. Rubanau

1. INTRODUCTION

The main aim of this paper is to create a mathematical model to forecast electricity load and to find correlation between electricity load and parameters (temperature, brightness and so on), by using clustering and classification algorithms.

From the expert knowledge are known that demand of the electricity load is highly correlated to the set of parameters, like day of the week, seasons, outside temperature, brightness and so on. Also are known that this correlation are non linear, that produce additional difficulties (obstacle) to make reasonable forecasting model.

2. THE MODEL

Let us split up the forecasting model (see figure 1) in to three major steps:

1) Clustering
2) Classification
3) Creating correlation function (mathematical model) between input and output

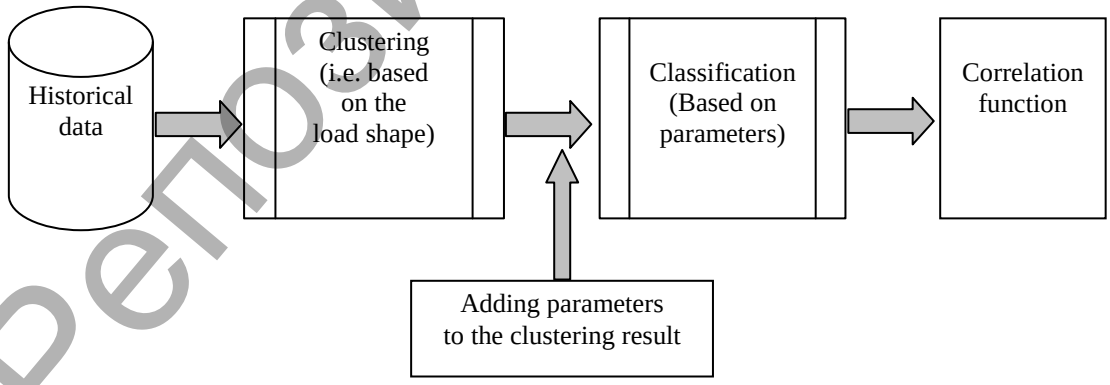

Figure 1. Mathematical model to forecast electricity load

At the first step we do clustering of the historical load data by using one of the clustering algorithm (k-means, hierarchical tree, SOM) [1,2,3], as result we have N clusters with different electricity load shapes, example of the clustering result is present in figure 2.

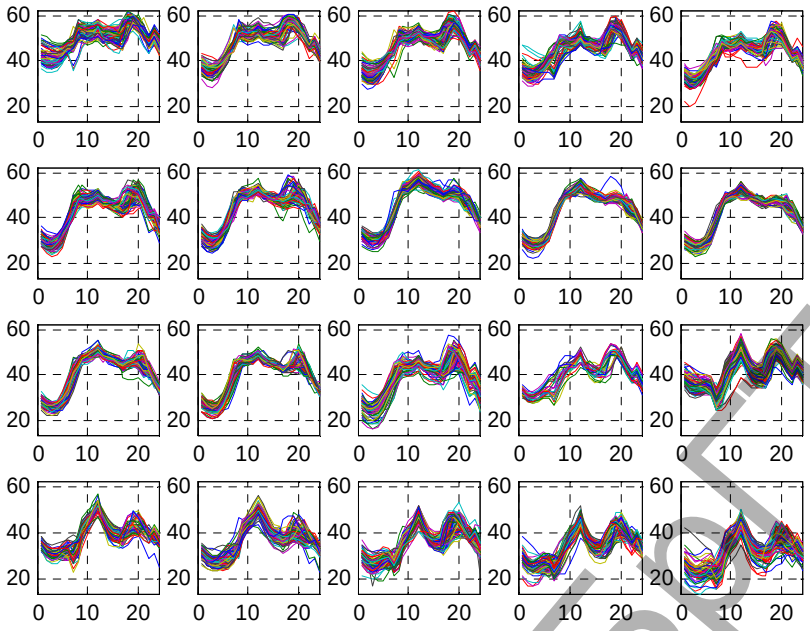

Figure 2. Clustering result

At the second step we create “parameters” table which contain description of each load curve in the cluster (i.e. days, month, season, temperature, and so on) and apply Probabilistic Neural Network algorithm to classification task [1]. The flow chart of this process you can see on figure 3. At this step we used only parameters of the day without any information about load shape at this day.

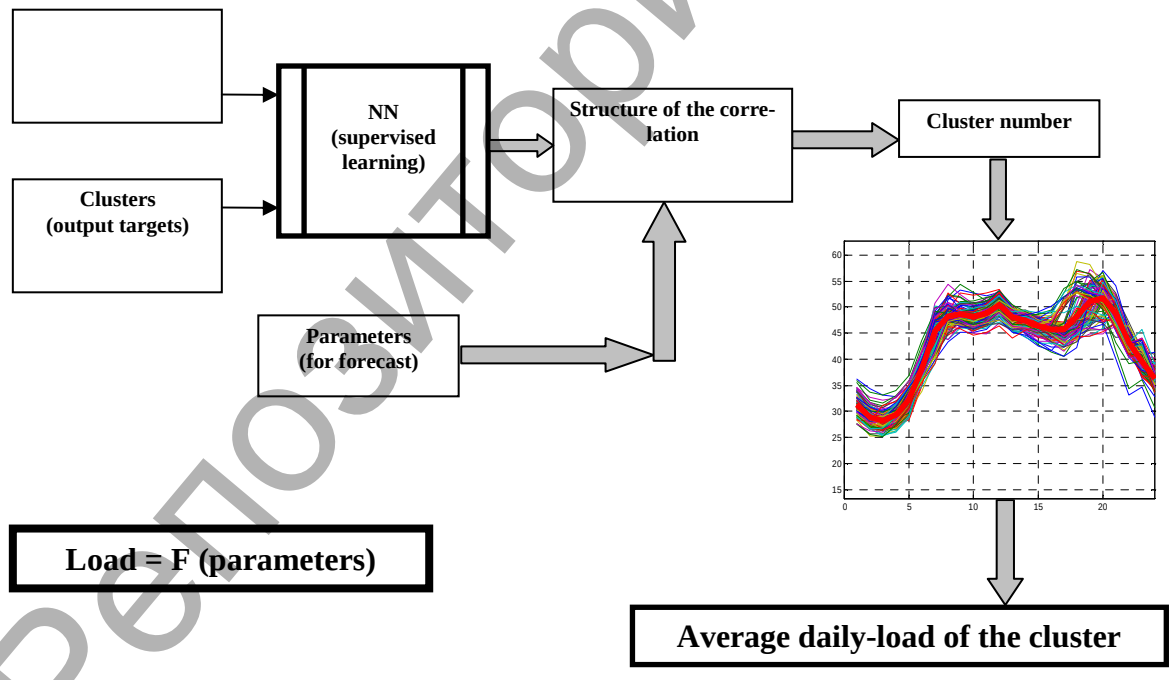

Figure 3. Flow chart of classification procedure

3. TESTING

The proposed model was tested with sets of historical data containing electricity load, daily temperature, brightness, wind, kind of the day from year 2000-2004 (years 2000-2003 was used as a historical data, year 2004 as a test year). The results of the simulation are presented in table 1. The error curves is presented in figure 4.

Table 1

Parameters:	**MAPE**	**N° clusters**
Week days, Saturday, Sunday, Holliday, Bridge days	8.19 %	**10**
Week days, Saturday, Sunday x Seasons, Holliday, Bridge days	7.30 %	**15**
Week days, Saturday, Sunday x Seasons, Holliday, Bridge days	7.03 %	**30**
Week days, Saturday, Sunday x Avg. Temp x Seasons, Holliday, Bridge days	6.85%	**35**
Just by taking average of year 2000-2003	9.92%	**1**

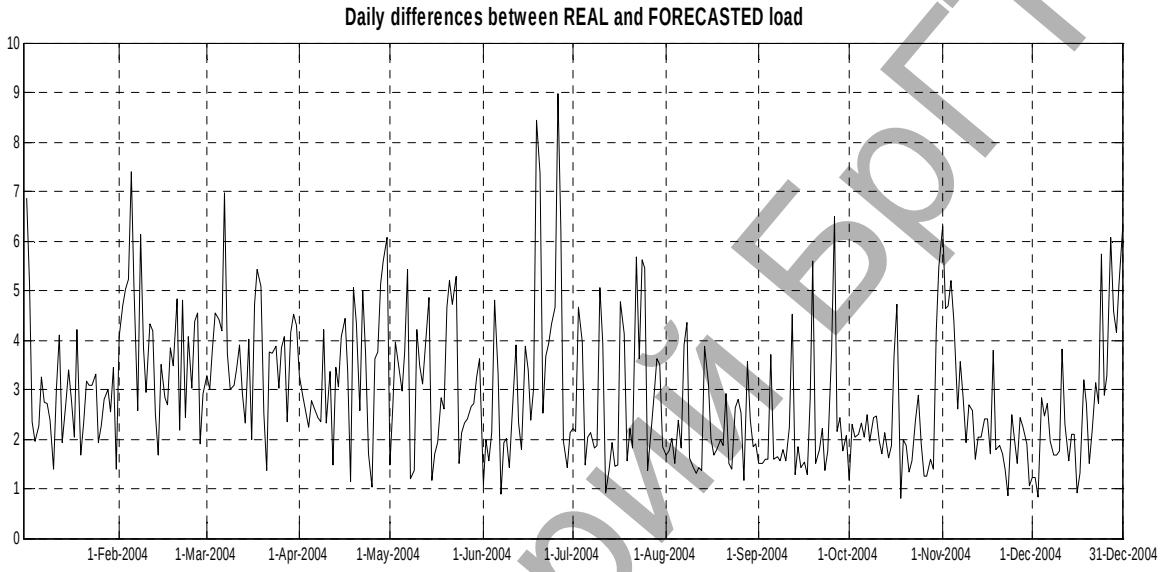

Figure 4. Error curves

CONCLUSION

The obtained error for one-year forecast is MAPE ≈ 7%, that could be read out as good result. However, as you can see in figure 4 some days have relative big error that means some of the important parameters were missed (or in other word taking as parameters: Week days, Saturday, Sunday, Avg. Temp, Seasons, Holliday, and Bridge days was not enough to correctly classify some of the days). One of the solutions for this problem could be applying statistical methods (i.e. linear regression) to find additional parameters (i.e. hours, night temperature) for classification step.

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СИСТЕМА АНАЛИЗА ХАОТИЧЕСКИХ СИГНАЛОВ НА БАЗЕ РЕКУРРЕНТНЫХ НЕЙРОННЫХ СЕТЕЙ

Савицкий Ю. В., Дунец А. П., Игнатюк О. Н., БГТУ, Брест

Нейросетевые методы анализа хаотических сигналов находят все большее применение в различных областях благодаря ряду преимуществ по сравнению с традиционными методами: возможностью исследования систем, математическая модель которых неизвестна (неизвестны математические соотношения, характеризующие поведение динамической