Title: " Application of self-organizing maps for classification and filtering of electrical customer load patterns"
Journal: International Journal of Power and Energy Systems Vol: 28, Pág: 83 - 88
January 2008

International Journal of Power and Energy Systems, Vol. 28, No. 1, 2008

APPLICATION OF SELF-ORGANIZING MAPS FOR CLASSIFICATION AND FILTERING OF ELECTRICAL CUSTOMER LOAD PATTERNS

S.V. Verdú,* M.O. García,* C.S. Blanes,* F.J.G. Franco,** and A.G. Marín***

Abstract

The objective of this research is to show the capability of the self-organizing maps (SOMs) to organize, filter, classify and extract patterns from distributor, commercializer, aggregator or customer electrical demand databases (the objective known as data mining). This approach basically uses – to reach the above-mentioned objectives – the historic load demand curves of each user. To get a better classification, some anomalous data – holidays, wrong measurements due to recorder failures – should be filtered before starting the map training. This preliminary step has been performed through an SOM map too. To show the proposed method in the paper only two typical medium users are studied on the filtering stage: an industry and a university both located in Spain. Subsequently, the filtering process is applied to a larger group of customers to finally prove the customer clustering capacity of SOM. The results clearly show the suitability of SOM approach to improve data management and to find easily coherent clusters between electrical users.

Key Words

Demand management, self-organizing maps, electrical customer segmentation, load patterns

1. Introduction

The deregulation process began in developed countries a decade ago trained by political and technological reasons. Unfortunately, the experience has not been as successful as was planned, due to a lot of problems which have appeared since 2000 up to now, e.g., California Energy Crisis in 2000 or blackouts in Europe, United States and Canada in 2003. Due to these experiences, regulators and system operators believe more and more that additional electricity resources – Distributed Energy Resources – should be procured using an integrated process that takes into account not only supply resources – Distributed Generation – but also some demand policies, e.g., efficiency gains in demand – in long term horizon – or price responsiveness – in short-term horizon. This supposes a new scenario where demand and supply compete on an equal footing in energy markets. For example, California Energy Commission will finance new energy efficiency programs to achieve a forecasted demand reduction of 6,000 GWh in 2008 [1]. The effective contribution to these energy efficiency programs and the necessity of offering energy choices to consumers need a detailed knowledge of customer segments and the characterization of these clusters, from the point of view of energy uses.

Besides, this new regulated framework of electrical power systems has promoted the necessity of new customer – and system – measurement, monitoring and control activities. This fact has increased the amount of data stored by supply side actors. The enormous quantity of available data presents a problem for utilities but also a non-negligible opportunity for distribution research. This high dimensional data set cannot be easily modelled and advanced tools for synthesizing structures from such information are needed.

This is the main objective of the so-called data mining techniques (DM) or more precisely knowledge discovery in databases (KDD) [2, 3], and it is also the research purpose of this work applied to customer characterization and segmentation.

2. Review of Customer Classification Methodologies

In previous research studies [3–5], the clustering ability, for data segmentation and aggregation, of different techniques has been compared. The techniques used in this paper in an initial approach can be grouped in two categories: neural networks and fuzzy logic techniques.

Work on artificial neural networks (ANNs) has been motivated right from its inception by the recognition that the human brain computes in an entirely different way from

* Universidad Miguel Hernández Avda. de la Universidad s/n, 03202. Elche, Spain; e-mail: {svalero, mortiz, csenabre}@umh.es
** Institute of Energy Engineering (IEE), U. Politécnica de Valencia, Spain; e-mail: garfrafr@iie.upv.es
*** Department of Electrical Engineering, Universidad Politécnica de Cartagena, Spain; e-mail: antonio.gabaldon@upct.es
Recommended by Dr. Carlos María Alvarez
(paper no. 203-3825)