Methods for customer and demand response policies selection in new electricity markets

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Abstract: Different methodologies are available for clustering and classification purposes. The objective of the research is to prove the capability of self-organising maps (SOMs) to classify customers and their response potential from distributor, commercialiser, or customer electrical demand databases, with the help of load response modelling methodologies as support tools. The search for customer suitability is restricted to day-ahead and real-time products, in which interest is growing in developed countries. Therefore customer demand and response (demand and distributed generation policies) have been tested and compared with price curves. Both steps have been performed through SOMs. The results clearly show the capability of this approach to improve data management and easily to find coherent policies to accomplish cleared-demand offers in different prices scenarios.

1 Introduction

The liberalisation process has not been as successful as was expected, owing to many problems that have appeared since 2000: for example, blackouts in Europe, USA and Canada in 2003. This has resulted in regulators and system operators believing more and more that distributed energy resources (DERs) should be procured using an integrated process that would take into account demand policies such as efficiency gains in demand or price responsiveness in long-term and short-term horizons, respectively. The effective contribution to these programmes and the necessity to offer energy choices to small and medium consumers require detailed knowledge of customer potential through definition of demand segments, knowledge of demand response, customer aggregation and the characterisation of these demand clusters.

The enormous quantity of available information is a non-negligible opportunity for distribution research. This high-dimensional data set cannot be modelled easily, and advanced tools to synthesise structures from such information are needed, i.e. data mining research [1] and applications [2]. The evaluation of and research into new applications in energy markets for these classification technologies are the aims of this work.

2 Load response programmes and opportunities

At the moment, different independent system operators (ISOs) in Europe, Oceania and North America are continuing the development of load response programmes (LRPs) with the objective of changing electricity demand of large power users. Nevertheless, some medium commercial or industrial users should submit offers and bids in new energy markets thanks to lighter requirements for demand reduction with levels of about 100 kW (New York ISO or New England ISO). Besides, some ISOs encourage the possibility of demand aggregation through commercialiser entities (see pilot programmes developed by NYISO since 2002 for small load aggregators [3]) to reach the minimum level for the participation of users.

These aggregators have several responsibilities:

- to provide the necessary load level according to the parameters of the cleared offer
- to notify customers of the necessary demand rescheduling resulting from accepted offers
- to assist customers in the determination of the best demand response policies mix according to demand curtailment period and price levels.

The present problem is how to detect the more suitable users to achieve a minimum change in demand level to comply with energy reductions in short- and medium-term markets with a fast time response. The methodology proposed in this paper is oriented to find opportunities in the day-ahead market (DAM) and real-time price market (RTPM).

In the first case, it is necessary to find customers with interest and capacity to bid load curtailments through an aggregator. Note that these curtailments, if any elasticity is expected [4], can be obtained through on-site small generation or by a change in the technology of the loads (for example, the use of dual-fuel loads). Clearly, the customer segments more interested in these policies should be those whose demand follows day-ahead prices. Better benefits could be achieved through a change in demand patterns when load follows energy prices if some demand elasticity exists. The first objective of this paper is to show the capability of self-organising maps (SOMs) to find the

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