

Resumen de Tesis Doctoral



DNI/NIE/Pasaporte

Nombre y apellidos

Título de la tesis

Unidad estructural

Programa

Códigos UNESCO

(Mínimo 1 y máximo 4, podéis verlos en <http://doctorat.upc.edu/gestion-academica/carpeta-impresos/tesis-matricula-y-deposito/codigos-unesco>)

Resumen de la tesis de 4000 caracteres máximo (si se superan los 4000 se cortará automáticamente)

In the current problematic energy context and particularly on the user side, an energy management system (EMS) is a suitable option for continuously improving energy efficiency, particularly on the user side. EMSs, in combination with information technologies, has given rise to intelligent EMS (iEMS), which, aside from lending support to monitoring and reporting functions as an EMS does, it has the ability to model, forecast, control and diagnose energy consumption in a predictive way. The main objective of an iEMS is to continuously improve energy efficiency (on-line) as automatically as possible.

The core of an iEMS is its load modeling forecasting system (LMFS). It takes advantage of historical information on energy consumption and energy-related variables in order to model and forecast load profiles and, if necessary, generator profiles. These models and forecasts are the main information used for iEMS applications for predictive control and diagnosis. LMFS on the user side are the focus of this thesis work.

The fact that the LMFS is applied on the user side to support an iEMS means that specific characteristics are required that in other areas of load forecasting they are not. First of all, the user-side load profiles (LPs) have a high random behavior. This makes the modeling and forecasting process more difficult. Second, on the user side --for example an industrial user-- there is a high number and variety of places that can be monitored, modeled and forecasted, as well as their precedence or nature. Thus, on the one hand, an LMFS requires a high degree of autonomy to automatically generate the demanded models. And on the other hand, it needs a high level of adaptability in order to be able to model and forecast different types of loads and different types of energies.

Therefore, the addressed LMFS are those that do not look only for accuracy, but also adaptability and autonomy. Seeking to achieve these objectives, in this thesis work we have proposed three novel LMFS schemes based on hybrid algorithms from computational intelligence, signal processing and statistical theory.

The first of them looked to improve adaptability, keeping in mind the importance of accuracy and autonomy. It was called an evolutionary training algorithm (ETA) and is based on adaptive-network-based-fuzzy-inference system (ANFIS) that is trained by a multi-objective genetic algorithm instead of its traditional training algorithm. As a result of this hybrid, the generalization capacity was improved (avoiding overfitting) and an easily adaptable training algorithm for new adaptive networks based on traditional ANFIS was obtained.

The second scheme deals with LMFS autonomy in order to build models from multiple loads automatically. Similar to the previous proposal, an ANFIS and a MOGA were used. In this case, the MOGA was used to find a near-optimal configuration for the ANFIS instead of training it. The LMFS relies on this configuration to work properly, as well as to maintain accuracy and generalization capabilities. Real data from an industrial scenario were used to test the proposed scheme and the multi-site modeling and self-configuration results were satisfactory. Furthermore, other algorithms were satisfactorily designed and tested for processing raw data in outlier detection and gap padding.

The last of the proposed approaches sought to improve accuracy while keeping autonomy and adaptability. It took advantage of dominant patterns (DPs) that have lower time resolution than the target LP, so they are easier to model and forecast. The Hilbert-Huang transform and Hilbert-spectral analysis were used for detecting and selecting the DPs. Those selected were used in a proposed scheme of partial models (PM) based on parallel ANFIS or artificial neural networks (ANN) to extract the information and give it to the main PM. Therefore, LMFS accuracy improved and the user-side LP noising problem was reduced.

Lugar

Fecha

Firma