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Editorial

Advanced Optimization Methods and Big Data Applications in Energy Demand Forecast

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The use of data collectors in energy systems is growing more and more. For example, smart sensors are now widely used in energy production and energy consumption systems. This implies that a huge amount of data are generated, and need to be analyzed in order to extract useful insights from it. Such Big Data gives rise to a number of opportunities and challenges for informed decision-making.

In recent years, researchers have been very actively working in order to come up with effective and powerful techniques in order to deal with the huge amount of data available. Such approaches can be used in the context of energy production and consumption, considering the amount of data produced by all samples and measurements, as well as including many additional features. With them, automated machine learning methods for extracting relevant patterns, high-performance computing, or data visualization are being successfully applied to energy demand forecasting.

In light of the above, this special issue was proposed in order to collect latest research on relevant topics, and in particular in energy demand forecast, and the use of advanced optimization methods and Big Data techniques. Here, by energy, we mean any kind of energy, e.g., electrical, solar, microwave, wind.

In response to the Call for Papers, eleven articles were submitted to this special issue, and five were accepted for publication. If we look at the techniques used in the accepted articles, we can notice that, in two articles, deep learning techniques were used in order to forecast energy demands. In particular, in [1], a Temporal Convolutional Network architecture was studied on two different pieces of data from Spain: the national electric demand and the power demand at charging stations for electric vehicles. In order to test the proposal, an extensive experimental study was conducted. The proposed model was compared with state-of-the-art deep learning-based techniques with different architectures and parametrization. Results show that the proposed model is competitive and outperformed the models used in the comparisons.

Deep Learning was also used in [2]. In this work, a neuro-evolution approach was used. In fact, the configurations parameter of the Neural Network used were set by using an Evolutionary Algorithm. The resulting architecture was applied to energy demand data registered in Spain over a period of more than nine years, and when compared to state-of-the-art approaches, proves to achieve better results.

In [3], the household sector is considered. In particular, data collected from residential homes of England and Wales are used. Such data are first clustered into three groups, according to the houses' consumption profile, and then a decision tree algorithms is used in order to extract insight regarding equipment that could affect energy efficiency. Authors identified various factors that can be addressed in order to improve energy efficiency in houses.

In the last few years, we have also seen a transaction toward green alternatives for energy generations. In order to face this transactions, the photovoltaic power plants' forecasting problem was tackled in [4]. Authors of this article took into consideration various

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external factors, like meteorological situations in order to produce the predictions. Authors have focused on data filtration, specifically for the data coming from open sources, like data regarding meteorological conditions. This process have proven to help in obtaining more accurate results.

In [5], the authors analyzed and discussed the parameters space of the multiple seasonal Holt–Winters models applied to electricity demand in Spain. This work studied the stability of the smoothing parameters in the multiple seasonal Holt–Winters models to provide accurate and trusted forecasts. In addition, the authors analyzed the variation of the parameters through different seasonal and trend methods. They argue that double seasonal models provide better predictions than triple seasonal ones. Furthermore, the authors established that, for the accuracy of the forecasts, no more than 5000 observations are required. The results of the performed analysis were limited to the Spanish electricity demand. However, the authors expect similar results when faced with load forecasting in other countries or systems.

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