Guest Editorial: Special Section on Forecasting in Modern Power Systems

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Power systems have been evolving during the past century. The electric grid is getting more and more sophisticated due to modern technologies and business requirements, such as implementation of smart grid technologies, deployment of utra-high voltage transmission systems, and integration of ultra-high levels of renewable resources. All of these factors are challenging today's energy forecasting practice. We have organized this special section of the Journal of Modern Power Systems and Clean Energy to answer the following question: How to better forecast the demand, supply and prices to accommodate the changes in modern power systems? The special section collects nine papers addressing various energy forecasting problems, including six on load forecasting, two on solar irradiance forecasting, and one on electricity price forecasting.

Most load forecasting models in the literature include calendar variables, such as hour of day, day of week, month of year and holidays. Nevertheless, not many papers in the literature are devoted to modeling various calendar effects. In the first paper entitled "Modeling public holidays in load forecasting: a German case study," Ziel analyzes pros and cons of different holiday effect modeling methodologies and compares them on a large load forecasting study. Readers may find the recommendations for treating public holidays in load forecasting quite insightful and useful in practice. In the second paper entitled "Load forecasting using 24 solar terms", Xie and Hong present a novel method of modeling the seasonal change for load forecasting by incorporating the 24 solar terms of China. The case study was based on the ISO New England data. The proposed model based on 24 solar terms outperforms the benchmark model based on the Gregorian calendar by up to 6.14%.

At the low voltage distribution systems, the batteries have limited capacity and high operational cost. In the third paper entitled "Load forecasting for diurnal management of community battery systems," Wolfs, et al. compare three load forecasting methods aiming at optimal management of community batteries. The methods include neural networks (NN), wavelet neural networks (WNN) and artificial neural network and fuzzy inference systems (ANFIS). The computational experiment is based on the data from the Perth Solar City high penetration photovoltaic (PV) field trials.

Industrial load forecasting is an area that has not received as much attention as many other load forecasting problems. In the fourth paper entitled "Day-ahead industrial load forecasting for electric RTG cranes," Alasali et al. focus on the electricity consumption at ports. Several short term industrial load forecasting models are tested on two different Rubber Tyred Gantry (RTG) crane data sets collected from the Port of Felixstowe in the UK, with the emphasis on two exogenous variables, number of crane moves and container gross weight.

Very short term load forecasting has been

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extensively studied in the literature, where most papers have assumed perfect knowledge of the lagged loads. In reality, however, the load values of the recent hours are often unavailable or inaccurate. In the fifth paper entitled “Real-time anomaly detection for very short-term load forecasting,” Luo, Hong and Yue propose a model-based anomaly detection method that consists of two components, a dynamic regression model and an adaptive anomaly threshold. The effectiveness of the proposed method is tested using the data from ISO New England.

Probabilistic load forecasting is an emerging topic in the recent years. In the sixth paper entitled “Embedding based quantile regression neural network for probabilistic load forecasting,” Gan et al. proposed a hybrid model considering both temperature uncertainty and load variation. The proposed quantile regression neural network model outperforms several benchmark models on the empirical study based on ISO New England data.

Accurate photovoltaic (PV) power generation forecasts are required for efficient management of Grid Connected Photovoltaic systems. Since solar irradiance is a key driver of the PV power generation, it is crucial to have accurate solar irradiance forecasts fed into a PV power forecasting system. The next two papers are devoted to solar irradiance forecasting. In the paper entitled “Photovoltaic yield prediction using an irradiance forecast model based on multiple neural networks,” Durrani et al. propose irradiance forecast model based on multiple feed-forward neural networks. According to the test case in Germany, the irradiance forecasts based on this proposed model lead to more accurate PV power forecasts than the benchmark based on the persistent method. In the other paper entitled “General noise support vector regression with non-constant uncertainty intervals for solar radiation prediction,” Prada and Dorronsoro focus on solar radiation forecasting. They propose a framework to include non-constant prediction intervals in general noise support vector regression models. Two test cases from previously held public competitions are used to demonstrate the effectiveness of the proposed models. Moreover, the authors also made the implementation available via public repositories as an effort to increase the reproducibility of the proposed work.

In a deregulated market, a retailer may issue the retail rates each month based on the price forecast of the next month. The accuracy of such medium term price forecasts becomes important to the financial bottom line of many retailers. The ninth and last paper entitled “Month ahead average daily electricity price profile forecasting based on a hybrid nonlinear regression and SVM model: an ERCOT case study,” Ma et al. brings a new problem to the electricity price forecasting field, forecasting the average daily price profile one month ahead. They propose a nonlinear regression model with deviation compensation. The case study is constructed using data from ERCOT.

We would like to thank all the authors for their carefully crafted, high quality papers. We would also like to thank the six guest editors for their critical and timely reviews of the submissions. Last but not least, special thanks are given to the editorial staff of Journal of Modern Power Systems and Clean Energy, whose diligent work has further enhanced the readability of the papers. We hope the readers enjoy reading this collection of energy forecasting papers.

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