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Editorial

Machine Learning and Data Mining Applications in Power Systems

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This Special Issue was intended as a forum to advance research and apply machine-learning and data-mining methods in order to facilitate the development of modern electric power systems, grids and devices, smart grids and protection devices, as well as to develop tools for more accurate and efficient power system analysis.

Conventional signal processing is no longer adequate to extract all the relevant information from distorted signals through filtering, estimation, and detection to facilitate decision making and control actions. Machine learning algorithms, optimization techniques and efficient numerical algorithms, distributed signal processing, machine learning, data-mining statistical signal detection, and estimation may help in solving contemporary challenges in modern power systems. The increased use of digital information and control technology can improve the grid's reliability, security, and efficiency; dynamic optimization of grid operations; demand response; incorporation of demand-side resources and integration of energy-efficient resources; distribution automation; and integration of smart appliances and consumer devices. Signal processing offers the tools needed to convert measurement data to information, and to transform information into actionable intelligence.

This Special Issue includes fifteen articles, authored by international research teams from several countries. For a straightforward browsing of the volume content, the articles can be grouped into the following subjects:

- Minority oversampling techniques applied to the detection of injection of false data and commands into communication [1].
- Binary-coded genetic algorithms applied to the intelligent scheduling of smart home appliances [2].
- Adaptive supervised dictionary learning (SDL) for wide-area stability assessment [3].
- Forecasting of consumption in isolated areas using data sequencing, sequential mining, and pattern mining to infer the results into a Hidden Markov Model (MAESHA H2020 project) [4].
- Impact of social distancing, implemented as a result of COVID-19, on residential energy consumption [5].
- Application of the IpDFT spectrum interpolation method to estimate the fundamental frequency of a power waveform [6].
- Application of an adaptive neuro-fuzzy inference system (ANFIS) maximum power point-tracking (MPPT) controller for DFIG-based wind-energy conversion systems (WECS) [7].
- Application of different cluster analysis techniques to evaluate the level of power quality (PQ) parameters of a virtual power plant [8–10].
- Application of Dynamic Differential Annealed Optimization to design of off-grid rural electrification in India using renewable energy resources and battery technologies [11].
- Reviews and studies of power supply quality pollution by voltage and current distortion [12–15].

To conclude, with reference to presented papers, we have seen a broad spectrum of data-mining and modern machine-learning techniques applied to recent problems of operation of power systems.

Data mining is a powerful new technology with great potential to help researchers focus on the most important information in their large databases. Machine learning aims to build computer systems that can learn how to solve complex problems by themselves. Deep learning builds a complex mathematical structure (a neural network) based on vast quantities of data. The two group of methods will eventually merge to provide more powerful tools for the unsupervised analysis of "big data" sets.

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