Guest Editorial
Special Section on Computational Intelligence Applications in Smart Grid

COMPUTATIONAL intelligence (CI) evolves computational models and tools of intelligence capable of handling large raw numerical sensory data directly, processing them by exploiting the representational parallelism and pipelining the problem, generating reliable and just-in-time responses, with high fault tolerance. Smart grid is evolved by embedding intelligence in the electricity infrastructure to enable bidirectional power flows in the transmission and distribution networks, whenever needed, to meet certain cost and environment performance requirements while satisfying system operating constraints such as stability, security, reliability and sustainability. The modern grid must have certain basic functions to be termed "smart" and these include: self-healing and fault tolerant characteristics; perform dynamic integration of all forms of electric energy generation and storage; and perform dynamic optimization of grid operations. This means solving multi-objective constrained optimization problems faster than real-time. CI methods are promising approaches to evolve the modern grid to be smart.

The objective of this Special Section is to address and disseminate state-of-the-art research and development in the applications of computational intelligence in smart grids. In response to the call for extended abstracts for this Special Section, 115 two-page extended abstracts were received and reviewed. Authors of 47 selected abstracts were then invited to submit full papers for a second round of review, and out of which 20 manuscripts were accepted and included in this Special Section.

The papers in this Special Section address a number of topics including:

- Optimal placement of phasor measurement units with emphasis on maximizing mutual information using an information-theoretic approach.
- Analysis and monitoring of frequency dynamics and harmonics in power networks using intelligent algorithms.
- Frequency regulation of a power system with distributed PV, energy storage, and electric vehicles using fuzzy logic.
- Wide area control of power systems to improve power system stability using reinforcement learning and approximate dynamic programming.
- Coordinated control and scheduling of wind farms to maximum their utilization using stochastic approaches.
- Power system operational planning considering small-signal enhancement using stochastic approaches.
- Making economic decisions in nodal electricity market based on system monitoring and alarm processing using a fuzzy reasoning petri-net model.
- Load forecasting using empirical mode decomposition and support vector machines.
- Optimal placement and operations of distributed generation using intelligent multi-agents.
- Computational tools and indices for assessing PV impacts and power quality distortions on distribution systems.
- Demand response and resource scheduling using intelligent algorithms.
- Microgrid management systems using intelligent multi-agents.

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