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EDITORIAL

Special issue on advanced computational intelligence systems for smart grids planning and management

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Technological advancements in the field of renewable energy systems (RES) are driving a wide and multidisciplinary interest toward the future electrical distribution networks. In order to fully exploit the available energy, electrical grids have to increase their sophistication, becoming smart grids (SGs). There are a variety of SGs definitions, which can be basically summarized as "intelligent" electricity networks, integrating a large number of conventional and unconventional power sources, often based on renewable energies and "active" users, fully coordinated among them by sophisticated management systems.

Many research and development issues of interest should be addressed in SGs, involving customers, utilities, energy providers, telecommunication companies, component and system producers, and financial organizations. In this context, significant enhancements can be accomplished by using advanced distributed and coordinated computational intelligence systems. These systems are, in fact, able to support full integration of RES, active participation of electricity customers in grid operations, dynamic optimization of grid operation, improved reliability, high power quality, high levels of grid security and efficiency.

Advanced computational intelligence methods that can be applied to solve challenging problems, contributing to a full realization of SGs include, among others, fuzzy logic and bio-inspired intelligence paradigms, such as neural networks, genetic algorithms, swarm intelligence, ant colonies and more.

In this context, it is a pleasure for us to introduce this Special Issue on "Advanced Computational Intelligence Systems for Smart Grids Planning and Management", including eight papers which have the aim of bringing some of the most recent and interesting concepts in this area by the worldwide research community and presenting some of the latest advancements and developments in the field of advanced computational intelligence systems dedicated to the SGs.

Di Fazio et al. describe recent management systems based on automatic controls and advanced information and communications technologies (ICTs) required for the realization of active networks and SGs. The paper evidences that in the development of smart distribution grids, a multidisciplinary approach is necessary. The development of new communication systems and their interfacing with the power system elements and of distribution management systems (DMSs) and energy management systems (EMSs), able to manage in a smart way the distributed system for energy production, consumption and storage, is in fact, necessary. Communication technology is seen as an essential enabling component of future SGs. In particular, smart meters, protection and control systems and two-way communicating devices represent the major components of the overall SG architecture.

The paper by G. Mokryani entitled "Optimal allocation of wind turbines in microgrids by using genetic algorithm" proposes a novel method for optimally allocating WTs in microgrids. The method combines the Genetic Algorithms (GA) and optimal power flow (OPF) to jointly minimize the total active power losses and maximize social welfare (SW) over a year. The GA is used to choose the optimal size while the OPF is used to determine the optimal number

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of WTs. The proposed method can help both WTs' developers and microgrid operators to better allocate WTs by considering cost reduction and consumers' benefits as well as total power loss reduction.

Y. Han et al. propose the use of the Karush–Kuhn–Tucker (KKT) conditions to develop a scheme for economic dispatch of load to generation units in a micro-grid. By using the KKT conditions, the true optimum can be found in the sense of minimizing the fuel consumption. The new approach is tested extensively in simulation against standard dispatch approaches, and its performance is seen to be superior in all cases.

G. Rigatos et al. propose a new method for fault diagnosis of nonlinear systems based on the modeling of the system's dynamics with feed-forward neural networks that use orthogonal basis functions exhibiting invariance to Fourier transform. A neural network with Gauss–Hermite polynomial activation functions has been used for approximating the nonlinear system's dynamics out of a set of input–output data. Evaluation tests have confirmed the efficiency of the proposed fault diagnosis method that can be applied to several electromechanical systems, e.g. vehicles, electric motors, power generators, etc.

M. L. Di Silvestre et al. propose a new methodology to devise efficient management strategies for electric vehicles (EVs) parking lots. A Monte Carlo approach is used to evaluate the load consumption profile for groups of EVs showing different features. The Monte Carlo approach allows combining the different social and economic features affecting the commercial penetration of EVs with the technical aspects. An interesting conclusion that can be drawn from the applications carried out is that the pricing strategy of the distributor should vary based on the parking lot composition and on the recharging features of the vehicles, in fact the technical objective to reduce power losses and the variance of the loads may not be concurrent with some currently adopted pricing structures.

Siano et al. propose an innovative decision support and energy management system (DSEMS) for residential applications. The DSEMS is represented as a finite state machine and consists of a series of scenarios that may be selected according to the user preferences. The designing and testing methods are described and some simulations results are presented in order to verify its effectiveness both in terms of continuity of electricity supply and energy savings and economics.

H. A. Khan et al. investigate the use of load forecasting in order to prevent overloading and catastrophic blackouts in power grids. A dual cerebellar model articulation controller (CMAC) neural network which is able to give an accurate very short term prediction of the required load curve is proposed. The paper depicts that the proposed method has the advantage of reduced training time and reduced computational requirements as compared to the other load forecasting techniques. The data of the south west interconnected system (SWIS) was employed to give load predictions whilst using the proposed dual CMAC and Back Propagation (BP) neural network. The performance evolution has shown that the proposed dual CMAC neural network works efficiently and accurately for very short term load forecasting scenarios as compared to other conventional load forecasting techniques.

The paper by G. Mokryani entitled "Fault ride-through enhancement of wind turbines in distribution networks" proposes a fuzzy controller for improving fault ride-through (FRT) capability of doubly fed induction generator based wind turbines (WTs). The controller is designed in order to compensate the voltage at the point of common coupling by regulating the reactive and active power generated by WTs simultaneously. The performances of the controller are assessed in different case studies. Simulation results reveal that the proposed controller can improve the FRT capability.

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