

## GUEST EDITORIAL PREFACE

# Special Issue on Mathematical and Heuristic Modeling and Optimization of Energy Systems, Part 2

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Challenging problems in the development of operation and control of modern energy systems require thorough detailed studies. Mathematical and heuristic modeling and optimization of energy systems are a powerful means for these studies. In the current issue the optimization is understood in a broad sense, including linear and nonlinear, continuous and discrete, heuristic and stochastic optimization, etc. At the same time the efficiency of optimization methods highly depends on mathematical and simulation models of the considered energy systems. Hence, another powerful means is a more advanced and sophisticated modeling technique, which takes into account specific features of modern energy systems. Finally, effective mathematical and heuristic approaches should be supported by reliable practical results. Therefore, the current

issue is also devoted to testing the suggested methods and corresponding models on real data in order to reveal their advantages and disadvantages.

Originally, the main direction in the studies of Energy Systems Institute, Siberian Branch of the Russian Academy of Sciences, in Irkutsk was the search for the best variants of creation, expansion and operation of complex energy facilities and systems for production of power, heat, oil and oil products, and the whole energy sector. The main tool in these studies is the mathematical and computer modeling and simulation. In order to implement the mathematical and computer models of energy system expansion and operation it is necessary to apply special computational mathematical methods and heuristic techniques. This second part of

the special issues of the *International Journal of Energy Optimization and Engineering* presents some new results in the above mentioned area of studies of Energy Systems Institute.

A two-level problem for electricity generation scheduling in the wholesale market environment is proposed in the paper by I.A. Nechaev and S.I. Palamarchuk. The lower level of the problem corresponds to System Operator's efforts to schedule generation and calculate local marginal prices on the basis of total production cost minimization. The upper level corresponds to the profit maximization of each Generating Company with true cost functions and true generation ranges. The problem is deemed to be solved, when the Nash equilibrium point among the strategic producers is reached. The two-level optimization problem is formulated and the method of its solving is developed.

The paper prepared by N.I. Ayzenberg and M.A. Kiseleva considers the mechanisms of organizing free trade in electricity market that are based on submitting bids of energy consumers and producers to the market operator. The authors discuss and compare possible strategies of generator behavior that lead to different equilibrium situations and correspond to the Cournot model and the models of supply function equilibria, and a perfectly competitive equilibrium. The mechanisms are tested on the basis of the Siberian electric power system.

The paper by I.N. Kolosok, E.S. Korkina and A.M. Glazunova deals with the placement of Phasor Measurement Units (PMU) based on heuristic methods, when solving the problem of electric power system state estimation. To check the efficiency of the PMU placement methods optimal in terms of the considered criteria, the authors used the method of test equations developed by them, taking into account the available traditional measurements. Experimental calculations showed good results

of solving PMU placement problems by using heuristic methods such as genetic algorithms, simulated annealing, etc.

Optimal training of artificial neural networks aimed at forecasting power system state variables is developed and discussed in the paper by V.G. Kurbatsky, D.N. Sidorov, N.V. Tomin and V.A. Spiryaev. The proposed method has two stages. At the first stage the input signal is decomposed into orthogonal basis functions based on the Hilbert-Huang transform. The genetic algorithm and simulated annealing algorithm are applied to optimal training of the artificial neural network and support a vector machine at the second stage. The results of applying the developed approach to the short-term forecasts of active power flows in the electric networks are presented.

Finally, intelligent computing based on cognitive and event modeling, and its application in energy security research are presented in the paper by L.V. Massel, V.L. Arshinsky and A.G. Massel. The authors suggest a two-level information technology for the research. The first level suggests a situation analysis using the intelligent computing techniques to choose rational strategies of energy development. At the second level these strategies are computed with the multi-agent software. Transition from the first to the second level is automated by the tools of deductive program synthesis that are based on declarative descriptions.

The above mentioned papers present different areas of research activity of Energy Systems Institute, which relate to different energy industries.

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