

Prospect of Meta-Heuristics Methods and Applications in Electric Power System

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The demand for electricity has grown due to the rapid economic development and gradual increase in the world's population. Efficient operation and planning of power systems become more important for a reliable and sustainable electricity supply. Optimization is playing a vital and dominant role in electric power system. Optimization problems in power system are diversified and they can be categorized in terms of the objective function characteristics and type of constraints. Most of them are commonly referred to as nonlinear and non-convex optimization problems. This leads to the difficulty in finding the global optimal solution. In recent years, methods based on artificial intelligence have been widely applied to a variety of fields in electrical engineering due to its outstanding characteristics for solving optimization problems with complex objective function and constraints. Meta-heuristics methods can be applied in different power system optimization problems including power system planning, maintenance scheduling, economic dispatch, optimal power flow, unit commitment, network reconfiguration for loss reduction, reactive sources allocation, optimal protection and switching devices placement and pollution dispatch of power plants, etc. [1-3]. In such way, it brings many benefits including total fuel cost saving, reducing transmission power losses, reduction of pollutant emissions, etc. Most of these works require formulation of mathematical models with extensive use of computational intelligence-based optimization techniques to solve many technical problems. This short note deals with the future prospect of meta-heuristics method in power system.

Previously, the classical methods are such as lambda iteration, Newton's method, gradient search, dynamic programming, linear programming, non-linear programming, and quadratic programming. These methods have proven their effectiveness in solving many optimization problems in electric power system with smooth and convex objective functions. However, most of these methods fail to obtain a global optimal solution for the problems with nonsmooth or non-convex objective functions [4, 5].

The researchers are trying to develop and apply modern meta-heuristics methods to deal with complex optimization problems with short computational times and exact solutions. These advanced methods based on artificial intelligence have been developed to deal with the optimization problems such as Hopfield neural network (HNN), evolutionary programming (EP), differential evolution (DE), genetic algorithm (GA), ant colony optimization (ACO), bacteria foraging optimization (BFO), artificial bee colony (ABC) algorithm, and particle swarm optimization (PSO), etc which have been successfully applied for solving nonsmooth or non-convex problems. This is due to their capacity to efficiently find the global optimal solution. However, artificial intelligence techniques often reach the near-global optimum. Hybrid methods which combine two or more optimization techniques are found to be more effective in finding the global optimal solution for the problems with nonsmooth or non-convex objective functions. However, the hybrid methods may be slower and more complicated than conventional methods due to the increase in algorithmic complexity [6].

Currently, the non-convex optimization problems always pose major challenges in term of optimal solution and computational time. The practical problems are non-linear, non-convex and multi-modal with multiple minima and a challenge for solution methods. A large amount of optimization techniques have been applied to deal with complex optimization problems in electric power system. Some of them are classical calculus-based techniques while others are based on artificial intelligence or hybrid methods. The methods based on artificial intelligence and hybrid approaches are very suitable for complex optimization problems. However, their search often results in a near global optimal solution [2, 4].

Although the optimization problems in electric power system have been solved for many years, the non-linear and non-convex problems are still a major challenge for solution methods in terms of optimal solution and computational time. Until now, there are no techniques which have been accepted as the best approach. Hence, there is a need for developing new techniques requiring the accurate, robust and fast solution for effectively solving these problems [3].

References

1. Khoa TH, Vasant PM, Balbir Singh MS, Dieu VN (2015) "Swarm-Based Mean-Variance Mapping Optimization (MVMOS) for Solving Non-Convex Economic Dispatch Problems." Handbook of Research on Swarm Intelligence in Engineering, IGI Publisher, 211.
2. Khoa TH, Vasant PM, Balbir Singh MS, Dieu VN (2015) "Solving economic dispatch problem with valve-point effects using swarm-based mean-variance mapping optimization (MVMOS)," Cogent Engineering, 2:1076983
3. Khoa TH, Vasant PM, Balbir Singh MS, Dieu VN (2015) "Solving Economic Dispatch By Using Swarm Based Mean-Variance Mapping Optimization (MVMOS)," Global Journal of Technology and Optimization,6
4. Khoa TH, Vasant PM, Balbir Singh MS, Dieu VN (2015) "Swarm Based Mean-Variance Mapping Optimization for Solving Economic Dispatch with Cubic Fuel Cost Function," in Intelligent Information and Database Systems. vol. 9012, N. T. Nguyen, B. Trawiński, and R. Kosala, Eds., ed: Springer International Publishing, 3-12.
5. Khoa TH, Vasant PM, Balbir Singh MS, Dieu VN (2014) "Swarm based mean-variance mapping optimization (MVMOS) for economic dispatch problem with valve point effects," in Industrial Engineering and Engineering Management (IEEM), 2014 IEEE International Conference, 59-63.
6. Khoa TH, Vasant PM, Balbir Singh MS, Dieu VN (2014) "Swarm based mean-variance mapping optimization (MVMOS) for solving economic dispatch," AIP Conference Proceedings, 1621:76-85

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