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GUEST EDITORIAL

Thematic issue on knowledge and data driven evolutionary multi-objective optimization

Ran Cheng[1] · Jinliang Ding[2] · Wenli Du[3] · Yaochu Jin[4]

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Evolutionary multi-objective optimization (EMO) algorithms are a family of nature-inspired algorithms widely used for solving multi-objective optimization problems. Since the operators (e.g., crossover, mutation, selection) in most traditional EMO algorithms are developed on the basis of fixed heuristic rules or strategies, they are unable to learn from data or knowledge, which has substantially limited the performance and applicability of EMO algorithms.

To equip EMO algorithms with *learning abilities*, increased attention has recently been paid to driving EMO by *knowledge* and *data*. Specifically, machine learning and statistical techniques are adopted to mimic *cognitive* functions, such as *learning* and *problem solving*, for assisting EMO algorithms in offspring generation, fitness evaluation, and/or environmental selection. Empowered by learning abilities, EMO algorithms are expected to be able to autonomously learn with experience, adaptively reusing data and/or machine learning models drawn from related problems as a priori knowledge in accomplishing new tasks. In light of such emerging topics in EMO research, this special issue aims at promoting first-class research outputs and offering a timely collection of findings to benefit the researchers and practitioners. We expect that the outputs of this special issue are not only helpful in pushing the boundaries of EMO research in academia, but also beneficial for meeting the requirements from industry. Based on a peer-review process, this special issue accepted eight papers for publication, four of them focusing on general complex multi-objective optimization problems and the rest four devoted to various applications.

The paper entitled "Handling Constrained Multi-objective Optimization Problems With Heterogeneous Evaluation Times: Proof-of-Principle Results" focuses on constrained multi-objective optimization problems with heterogeneous and expensive function evaluations. The paper studies efficient and adaptive ways of scheduling evaluations of different functional groups and constraints. The paper entitled "Constrained Multi-objective Optimization with a Limited Budget of Function Evaluations" proposes a self-adaptive evolutionary algorithm for solving multi-objective constrained optimization problems by using Radial Basis Function approximations. Given a constrained multi-objective optimization problem, the proposed algorithm automatically determines to use the Radial Basis Function-fit as surrogate models whether for the objectives or the constraints. The paper entitled "Solving Large-Scale Multi-Objective Optimization via Probabilistic Prediction Model" focuses on multi-objective optimization problems with a large number of decision variables, i.e., large-scale multi-objective optimization problems. In order to improve the efficiency of sampling candidate solutions in the high-dimensional decision space, the paper proposes an evolutionary algorithm based on a probabilistic prediction model. The paper entitled "A Framework for Expensive Many-Objective Optimization with Pareto-Based Bi-indicator Infill Sampling Criterion" focuses on many-objective optimization problems with expensive function evaluations. In order to perform efficient evolutionary surrogate-assisted optimization, the paper proposes a generic framework with a Pareto-based bi-indicator infill sampling criterion. The paper entitled "A Multi-objective Memetic Algorithm for Integrated Process Planning and Scheduling Problem in Distributed Heterogeneous Manufacturing Systems" is devoted to solving planning and scheduling problems in distributed heterogeneous manufacturing systems. The paper first establishes a mixed-integer linear programming model by simultaneously considering the multiple optimization objectives related to makespan and machine

✉ Ran Cheng
ranchengcn@gmail.com

[1] Department of Computer Science and Engineering, Southern University of Science and Technology, Shenzhen, China

[2] Department of Automation, Northeastern University, Shenyang, China

[3] Department of Automation, East China University of Science and Technology, Shanghai, China

[4] Faculty of Technology, Bielefeld University, Bielefeld, Germany

load simultaneously, and then proposes a tailored multi-objective memetic algorithm for optimization. The paper entitled "Multi-objective Deep Reinforcement Learning for Emergency Scheduling in a Water Distribution Network" is dedicated to dealing with emergency scheduling problems in water distribution networks by considering the uncertain environment and randomness of water demands. In order to effectively schedule water valves and fire hydrants to isolate contaminated water and reduce the residual concentration of contaminants in water distribution networks, the paper first formulates the problem into a multi-objective optimization problem with two objectives, and then proposes a reinforcement learning-based algorithm for optimization. The paper entitled "Preference based Multi-Objective Reinforcement Learning for Multi-Microgrid System Optimization Problem in Smart Grid" is dedicated to meeting the challenges of the operation control for a multi-microgrid system in smart grid. To design a multi-microgrid power system, the paper considers the power system model in a multi-layer manner, and then proposes a preference-based multi-objective reinforcement learning approach for optimization. The paper entitled "Adaptive Multiobjective Evolutionary Algorithm for Large-Scale Transformer Ratio Error Estimation" is dedicated to solving voltage transformer ratio error estimation problems in power systems. The paper models the voltage transformer ratio error estimation problems into large-scale multi-objective optimization problems, and then proposes a tailored evolutionary algorithm which is able to adaptively choose offspring generation and environmental selection operators for optimization.

The Guest Editors would like to thank all authors who responded to the call for papers and reviewers who offered their expertise and competence in order to compose this special issue in this constantly growing niche of Memetic Computing. The Guest Editors would also like to thank the Editor-in-Chief, Prof. Chuan-Kang Ting, for his strong support and consistent dedication to the quality of the journal.