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EDITORIAL

Guest editorial for special issue "Emerging topics in evolutionary multiobjective optimization"

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Most real-world optimization problems involve multiple, often conflicting, objectives to be optimized simultaneously, known as multiobjective optimization problems (MOPs). To solve MOPs, the area of evolutionary multiobjective optimization (EMO) has witnessed rapid development since the late 1990 s. Thanks to their population-based nature, EMO algorithms can obtain a set of solutions simultaneously, which provides sufficient information for decision-making, making them applicable and practical in dealing with complex application scenarios.

In the past decades, the complexity of real-world MOPs has substantially increased. Many emerging optimization problems involve dealing with many/computationally expensive objectives/tasks, a huge number of variables, nonlinear relationships, irregular Pareto optimal front (PF), and/or in a dynamic and uncertain environment. Such problems have posed great challenges to the EMO area. For example, classical EMO algorithms may fail to find a solution set that can cover the entire PF uniformly on MOPs with irregular PFs; as the increase in the number of decision variables and/or objectives, the performance of traditional EMO algorithms could degenerate dramatically, e.g., they can hardly converge to the PF; as the decrease in the number of available function evaluations for real-world computationally expensive MOPs, final solutions obtained by conventional EMO algorithms could be far from the PF; if the environment of a dynamic MOP change sharply/rapidly, there may leave little information/time for the EMO algorithm to track the Pareto optimal set effectively/efficiently.

In light of those emerging topics in EMO, this special issue aims to promote and offer a timely collection of recent EMO research works to benefit the researchers. To be specific, it is of particular interest in terms of how to perform interdisciplinary research on EMO using state-of-the-art computational intelligence and multi-criteria decision-making theories, methods, and techniques. We expect that this special issue will be beneficial for encouraging interdisciplinary research in both academia and industry. This special issue accepted seven papers for publication based on a peer-review process. Six of them focused on handling MOPs with expensive objectives, large-scale decision variables, irregular PFs, dynamic and multi-task environments, interactive decision-making, and one is devoted to the neural architecture search.

The paper entitled "Adjusting Normalization Bounds to Improve Hypervolume-based Search for Expensive Multi-objective Optimization" focuses on computationally expensive multi/many-objective optimization. This paper considered the predicted hypervolume maximization as the infill criterion, and then proposed a scalable approach based on the "surrogate corner". The paper entitled "Improved SparseEA for Sparse Large-scale Multi-objective Optimization Problems" focuses on solving sparse MOPs with large-scale decision variables. By using a two-layer encoding scheme with the assistance of variable grouping techniques, the connection between real variables and binary variables is enhanced to strike a balance between sparsity maintenance and variable optimization. The paper entitled "Multi-Objective Multi-Criteria Evolutionary Algorithm for Multi-Objective Multi-Task Optimization" focuses on solving multi-objective multi-task optimization problems (MO-MTOPs). Instead of treating the multiple tasks as different objectives directly, this work treats the MO-MTOP as a multi-objective multi-criteria optimization problem, aiming to fully utilize the knowledge from all tasks to solve the MO-MTOP more efficiently. The paper entitled "Comparing Interactive

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Evolutionary Multiobjective Optimization Methods with an Artificial Decision Maker" focuses on developing artificial decision-makers (ADMs) for interactive EMO. Compared with existing ADMs that only consider one type of preference information, the learning and decision phases of interactive solution processes are considered in the study. Specifically, a tailored ADM is proposed for generating preference information to reflect the nature of the phases in interactive solution processes. The paper entitled "The Dilemma Between Eliminating Dominance Resistant Solutions and Preserving Boundary Solutions of Extremely Convex Pareto Fronts" focuses on algorithmic analysis in dealing with extremely convex PFs.A new benchmark MOP with extremely convex PF is designed to investigate the boundary solution preservation and dominance-resistant solution elimination in existing EMO algorithms. The paper entitled "Improved NSGA-III Using Transfer Learning and Centroid Distance for Dynamic Multi-objective Optimization" focuses on dynamic multiobjective optimization. By proposing a centroid distance-based prediction strategy cooperating with a transfer learning strategy, an improved NSGA-III is developed to track the varying environment effectively. The paper entitled "Accelerating Multi-objective Neural Architecture Search by Random-Weight Evaluation" focuses on evolutionary multiobjective neural architecture search (NAS). To reduce the cost of performance estimation in NAS, a performance estimation metric based on random-weight evaluation is proposed to quantify the quality of neural networks. In addition, a complexity metric for measuring the model complexity is adopted to balance the model size and performance.

The Guest Editors would like to thank all authors who responded to the call for papers and reviewers who offered their expertise and competence to compose this special issue in Complex & Intelligent Systems. The Guest Editors would also like to thank the Editor-in-Chief (Prof. Yaochu Jin) and all the committee members of EMO 2021, for their strong support and consistent dedication to the quality of the journal.