Guest Editorial: Special issue on memetic algorithms with learning strategy

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Published online: 19 May 2021

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Memetic algorithm (MA) represents one of the successful extension of evolutionary algorithm (EA). The term MA is now widely used as a synergy of evolutionary or any population-based approach with separate individual learning or local improvement procedures for optimization. During the last decade, it has been demonstrated that MAs are able to converge to high quality solutions more efficiently than their conventional counterparts on a wide range of real world problems. Despite the success and surge in interests on MAs, many successful MAs reported in the literature have been crafted to suit problems in very specific domains.

Nowadays, it is well recognized that the process of learning is central to humans in problem-solving. Learning has been established to be fundamental to human in functioning and adapting to the fast evolving society. To enhance the optimization capability when solving complex problems, it is very important to use learning strategy and control scheme in MAs. Particular examples may include the learning of adaptive approach to control the configuration of local searches in MA along the evolutionary search, the learning of historical successes in algorithm configuration and high quality solutions to enhance the MA search on unseen problems, reinforcement learning assisted MA, deep learning assisted MA, etc. Within the context of computational intelligence, several core learning technologies in fuzzy system and neural network have been notable for the ability in modeling human's leaning and generalization capabilities for dealing with complex real-world applications. In spite of the accomplishments made in computational intelligence, the attempts to emulate the learning mechanisms of human in search, MAs in particular, for intelligent and automated

optimization and decision-making, have to date received far less attention.

This special issue aims to explore and encourage the current and ongoing research progress in memetic computation, especially the design and utilization of learning strategy in MAs towards automated and advanced memetic optimization process. Following a rigorous peer review process, seven papers have been accepted to be included in the special issue.

The first paper, "A light-robust-optimization model and an effective memetic algorithm for an open vehicle routing problem under uncertain travel times" by Sun et al. presents an effective MA for solving the open vehicle routing problem with predetermined time windows under uncertain travel times (OVRP-UT). In the proposed method, learning strategy has been proposed to adaptively control the frequency of performing crossover and mutation during the evolutionary search process. New initialization, crossover and mutation operators have also been proposed in the MA regarding the property of OVRP-UT. Comprehensive empirical study on 320 benchmark instances have been conducted to investigate the performance of the proposed method.

In the second paper entitled "An effective memetic algorithm for UAV routing and orientation under uncertain navigation environments", Shang et al. propose an effective MA for unmanned aerial vehicle (UAV) routing and orientation under navigational, steering and uncertain constraints. In the proposed MA, the global search performs the outer loop for optimizing the route, while the local search metaheuristic focuses on the inner loop for optimizing the orientations. A database recording knowledge of high-quality subroutes along the search process is used to accelerate the inner optimization in the MA. Experiments on open-access datasets show the effectiveness of the proposed MA for providing high-quality route with orientations for UAV.

To improve the operational efficiency of supply chain, an adaptive human-learning-based genetic algorithm for solving the integrated production and distribution scheduling

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problem has been proposed by Qin et al. in their paper “Integrated Production and Distribution Scheduling in Distributed Hybrid Flow Shops”. The proposed method hybridizes an adaptive learning operator with crossover and mutation to enhance the global and local search ability.

The forth paper, “Integrated scheduling problem for earth observation satellites based on three modeling frameworks: an adaptive bi-objective memetic algorithm” by Chang et al. embarks a study on the scheduling of data acquisition and data transmission for earth observation satellites. In particular, an adaptive bi-objective MA which integrates the non-dominated sorting genetic algorithm II (NSGA-II) and an adaptive large neighborhood local search algorithm has been proposed in this paper. The efficacy of the proposed method has been extensively investigated using real-world data sets.

To solve the challenging bilevel optimization problems, Wu et al. proposed an efficient self-adaptive bilevel differential evolution (SABILDE) with kNN approximation for the lower level optimization in “An efficient bilevel differential evolution algorithm with adaptation of lower level population size and search radius”. The proposed self-adaptive control rate and the introduction of the archiving technique play key roles in improving the efficiency of the optimization algorithm. The performance of the proposed algorithm has been evaluated on 10 standard bilevel test problems and the benchmark suite with 12 scalable test problems.

In the sixth paper entitled “An Adaptive Multiobjective Evolutionary Algorithm Based on Grid Subspaces”, to solve multi-objective optimization problems efficiently, Li et al.

present an adaptive multi-objective evolutionary algorithm with the concepts of the grid system. Based on grid, the objective space is divided into subspaces, which are adaptively selected for allocating search resources based on the quality and dominance relationship between subspaces.

Last but not the least, Peng et al. in their paper “A novel non-dominated sorting genetic algorithm for solving the triple objective project scheduling problem”, addressed the multi-mode resource constrained project scheduling problem with three objectives, which are minimizing the project duration, minimizing the resource investment and maximizing the robustness of the schedule. To solve this problem, this paper proposed a modified serial schedule generation scheme and a simplified normalization method in the non-dominated sorting genetic algorithm III (NSGA-III).

The guest editors would like to thank all the authors who submitted their work to the special issue, and all reviewers for their hard work in completing timely and constructive reviews. Special thanks also go to the Editors-in-Chief and members of the editorial team for their support during the editing process of this Special Issue.

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