Special issue on “Data-driven evolutionary optimization”

Yaochu Jin¹ · Jinliang Ding²

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Many real-world optimization problems do not have an analytical objective function for performing optimization. Instead, only numerical simulations or physical experiments can be conducted for evaluating the quality of candidate designs. In these cases, data-driven evolutionary optimization approaches, typically assisted by surrogate models, can be adopted.

This special issue aims to present recent advances in data-driven optimization and learning problems.

We have received over 35 submissions in total, and 11 papers have been accepted to be included in this special issue after a peer review process. These papers involve a wide range of optimization problems, ranging from face recognition, robot path planning, to sensor networks and logistics, representing various optimization problems commonly seen in the real world.

The first paper, “Intelligent welding robot path optimization based on discrete elite PSO” by Wang *et al.* proposes an optimization strategy based on particle swarm optimization to solve double welding robot path optimization problem that minimizes the path length and the welding deformation with constraints of avoiding mutual influence.

No single evolutionary algorithm can work efficiently for all problems. For this reason, the second paper titled “Hyper multi-objective evolutionary algorithm for multi-objective optimization problems” by Guo *et al.* combines three popu-

lar multi-objective evolutionary algorithms in an attempt to achieve robust performance on different optimization problems.

To address problems of fault-tolerant routing recovery and routings’ quality maintenance in energy harvesting wireless sensor networks, the third paper titled “An improved immune system-inspired routing recovery scheme for energy harvesting wireless sensor networks” by Zhang *et al.* proposes an improved immune system-inspired routing recovery algorithm to provide an intelligent scheme for such networks.

The fourth paper, “Streaming data anomaly detection method based on hyper-grid structure and online ensemble learning” by Ding *et al.* proposes a novel online streaming data anomaly detection method. In this algorithm, an improved L1 detection neighbor region is introduced to optimize the initial hyper-grid-based anomaly detection method by decreasing the quantity of neighbor detection region, and then online ensemble learning adapts to the distribution evolving characteristic of streaming data and overcomes the difficulty of obtaining the optimal hyper-grid structure.

The fifth paper, “An online learning neural network ensembles with random weights for regression of sequential data stream” by Ding *et al.* presents a novel online sequential learning algorithm for neural network ensembles for online regression. The algorithm is built upon the decorrelated neural network ensembles, and it only learns the newly arrived data to reduce the computation complexity. Experimental results show the effectiveness and advantages of the proposed approach.

Differential evolution has been shown to be very successful for solving various optimization problems. The sixth paper, “New mutation strategies of differential evolution based on clearing niche mechanism” by Li *et al.* aims to propose new mutation strategies for differential evolution by applying the clearing niche mechanism to the existing

✉ Yaochu Jin
yaochu.jin@surrey.ac.uk

Jinliang Ding
jlding@mail.neu.edu.cn

¹ Department of Computer Science, University of Surrey, Guildford, UK

² State Key Lab of Synthetical Automation for Process Industries, Northeastern University, Shenyang, China

mutation strategies. Instead of using random, best or target individuals as base vector, the niche individuals are utilized in these strategies. The new mutation strategies are shown to be beneficial to the balance among population diversity, search capability and convergence.

The seventh paper, “A hybrid evolutionary algorithm with adaptive multi-population strategy for multiobjective optimization problems” by Wang *et al.* proposes a multi-population evolutionary algorithm that combines the strength of differential evolution and particle swarm optimization. Comprehensive experiments on a set of benchmarks are conducted to demonstrate the advantage of the proposed algorithm over several state-of-the-art multi-objective evolutionary algorithms.

Face recognition has wide applications in the real world. “Improved immune computation for high-precision face recognition” by Gong adapts the immune computation for better face recognition to decrease the facial disturbances of the pose, illumination and expression. Experimental results show that this immune algorithm outperforms several state-of-the-art algorithms in the face recognition accuracy tests on several facial image databases.

The ninth paper, “A hybrid artificial bee colony for optimizing a reverse logistics network system” by Li *et al.* suggests a hybrid discrete artificial bee colony algorithm for solving the location allocation problem in reverse logistics network system. Eight well-designed neighborhood structures are proposed to utilize the problem structure and can thus enhance the exploitation capability of the algorithm.

The tenth paper titled “Coverage enhancing of 3D underwater sensor networks based on improved fruit fly optimiza-

tion algorithm” by Li *et al.* develops an optimal algorithm for coverage enhancing of 3D underwater sensor networks based on an improved fruit fly optimization algorithm. This method aims to achieve the global optimal coverage based on foraging behavior of fruit flies and is shown to be able to achieve fast convergence, with a small number of parameters being set up. Simulation result indicates that the proposed method can significantly improve the effective coverage rate of the sensor networks.

The last paper titled “Data based multiple criteria decision-making model and visualized monitoring of urban drinking water quality” by Yan *et al.* proposes a multiple criteria decision-making model to evaluate, analyze and monitor the urban drinking water quality by integrating analytic hierarchy processes, Kullback–Leibler divergence ratio and comprehensive weighted index method to evaluate the quality of drinking water comprehensively. The proposed method is applied to real-time comprehensive evaluation and visualized monitoring of drinking water quality in Shanghai city.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.