EDITORIAL

Special issue on "real-world optimization problems and meta-heuristics"

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Real-world problems have mostly unknown search spaces with a large number of difficulties. In the field of optimization, such difficulties significantly degrade the performance of optimization algorithms that performed well on benchmark functions or simple case studies. To ensure quality of solutions obtained for optimization problems, scientists and practitioners need to identify the difficulties and incorporate proper changes, modifications, and improvements in the algorithms to tackle such challenges.

The literature shows that meta-heuristics have been very popular lately and widely applied to real-world problems in diverse fields. The stochastic nature of such methods allows them to find near-optimal solutions in a reasonable time for real-world, often NP hard, problems. Although meta-heuristics are general-purpose optimizers and problem-independent, they cannot be efficiently used without considering the challenges mentioned above and incorporating changes required when applying to real-world problems.

The main objective of this special issue is to provide a collection of recent developments and applications in the area of meta-heuristics through the lens of common difficulties. The focus is on the recent development to tackle the challenges that an algorithm might face when solving real-world problems and applications which bring something new to the meta-heuristic algorithms domain.

The special issue required the authors to provide complete and substantial algorithmic comparisons that illustrate why the proposed approach is preferable in the application investigated. The authors were requested to analyse the mechanism of the algorithm used in the experiments, discuss the benefits or disadvantages, and provide a robust complexity analysis.

A summary of all accepted papers in this special issue are as follows:

- In the paper entitled "Modeling and optimization of a reliable blood supply chain network in crisis considering blood compatibility", Ghorashi and Hamedi solved an important problem in blood supply chain in emergency situations. The real case study was related to the capital of Iran, Tehran. The importance of such an efficient medical supply chain is evident especially after the COVID-19 pandemic. In this work, the authors effectively compared MOGWO, MOPSO, and NSGA-II in this important problem. Therefore, the main challenge considered was addressing multiple conflicting objectives.

- In the work entitled "Feature selection using binary grey wolf optimizer with elite-based crossover for Arabic text classification", Chantar et al. proposed binary variant of Grey Wolf Optimizer (GWO). The proposed method was designed to perform feature selection as a binary algorithm. The proposed method was employed for classification of Arabic texts. The main challenge considered was the existence of many decision variables in the feature selection problem.

- In the paper entitled "A non-convex economic load dispatch problem with valve loading effect using a hybrid grey wolf optimizer", Al-Betar et al. combined GWO with beta Hill Climbing to solve non-convex economic load dispatch problem. The main challenges were non-convex search spaces and locally optimal solutions.

- In the paper entitled "An improved cuckoo search algorithm with self-adaptive knowledge Learning", Li et al. improved the Cuckoo Search (CS) algorithm. The improved algorithm was compared with other variants of CS, DE, and PSO. A wide range of classical engineering problems was solved to showcase the

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merits of the proposed method. This paper focused on the challenges involved in single-objective optimization.

- In the paper entitled "Exploiting Flower Constancy in Flower Pollination Algorithm: Improved Biotic Flower Pollination Algorithm and its Experimental Evaluation", Kopciewicz and Lukasik proposed Biotic Flower Pollination Algorithm (BFPA) and compared it with original FPA, PSO, LEFPA, and SOS. The proposed BFPA was applied to a set of problems in the area of probabilistic modelling. The challenges considered in this work centred around the existence of locally optimal solution.

- In the paper entitled "A non-revisiting quantum-behaved particle swarm optimization based multilevel thresholding for image segmentation", Yand and Wu proposed a modified quantum-behaved particle swarm optimization (MQPSO) and extensively compared it with ABC, GWO, and other PSO variants. The authors employed MQPSO to segment images. The main challenge targeted in this paper was the avoidance of premature convergence and handling large-scale search spaces.

- In the paper entitled "Solving Multiple Travelling Officers Problem with Population-based Optimization Algorithms", Qin et al. solved Travelling Officer Problem using Cuckoo Search, Genetic Algorithm, and Particle Swarm Optimization. The authors considered multiple officers in the MTO problem, which makes it significantly more difficult to solve. The main challenges in this problem area were the graph-based and combinatorial nature of the search space. Therefore, the authors had to use the binary mechanisms and operators in the meta-heuristics.

- In the paper entitled "Network characteristics for neighborhood field algorithms", Ao et al. proposed a variant of Neighborhood Field Optimization algorithm (NFO). The NFO algorithm was significantly improved and compared to PSO and DE. There are extensive analytical analysis of algorithms and discussions on the potential applications of the proposed method too. The difficulty targeted in this paper was how to improve an algorithm without increasing the computational complexity.

- In the paper entitled "Optimum Design of Reinforced Earth Walls Using Evolutionary Optimization Algorithms", Kashani et al. optimized the design of mechanically stabilized earth (MSE) using geosynthetics. Differential Evolution, Evolutionary Strategy, and Biogeography-Based Optimization algorithm were used. The main challenge in this problem was the existence of variables with diverse types and ranges.

- In the paper entitled "PSO-based novel resource scheduling technique to improve QoS parameters in cloud computing", Kumar and Sharma solved a multi-objective version of scheduling problem. The authors compared several meta-heuristics (e.g. PSO, ABC, DLBE, and IMMLB). They also discussed pros and cons of each algorithm in cloud environments. In the end, the authors proposed an improved version of PSO called PSO-BOOST. The difficulties of this problem were the mixed-integer variables and a large number of constraints.

- In the paper entitled "Evolutionary model construction for electricity consumption prediction", Song et al. proposed a two-step Evolutionary Algorithm (EA) and compared it with a number of other meta-heuristics. The real-world application is to predict electricity consumption. The main challenges were multi-stage optimization processes combined with Machine Learning methods required for solving the problem.

- In the paper entitled "Normal Parameter Reduction Algorithm in Soft Set based on Hybrid Binary Particle Swarm and Biogeography Optimizer", Sadiq et al. proposed a hybrid of PSO and BBO algorithm to minimize choice costs. Extensive comparisons were provided with other meta-heuristics, including BBO, PSO, GA, ACO, ES, and PBIL. The main difficulty in this paper was the binary nature of the problem.