

Guest Editorial Preface

Special Issue on Bio-inspired Computing in Engineering Problem Solving

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An algorithm must be seen to be believed.
- Donald Knuth

Optimization problems solving is an active research area including approximate and exact algorithms. Designing and implementing optimization algorithms are based on several methods such as branch and bound methods and dynamic programming. These optimization algorithms have superior performance in many problems. However, in several applications, the search space increases exponentially with the problem size. This exhaustive search is impractical in solving such problems. In order to overcome the limitations and to solve efficiently larger scale of combinatorial and highly nonlinear optimization problems, a set of more flexible and adaptable algorithms are compulsory. Based on this inspiration, numerous algorithms usually inspired by natural phenomena have been designed and developed by researchers to solve engineering problems. Some meta-heuristic search algorithms with population based framework are capable to handle high dimension optimization real-world engineering problems in several domains including medical, industry, education, and military.

Genetic Algorithm (GA), Particle Swarm Optimization (PSO), Ant Colony Optimization (ACO), Artificial Bee Colony (ABC), Firefly algorithm (FFA), Artificial Immune System (AIS), Intelligent Water Drops (IWD), River Formation Dynamics (RFD), Social Group Optimization (SGO) algorithm, Gravitational Search Algorithm (GSA) and Charged System Search (CSS) are efficiently designed and implemented. Such algorithms and their developed schemes provide superior performance in extensive range of problems such as pattern recognition, image processing, neural network training, function optimization, data mining, and combinatorial optimization problems to support various applications.

The current special issue includes seven articles as follows. In the first article, Moghaddam et al. formulated the block-model problem as an optimization problem using descriptive mode and statistical mode. A genetic algorithm has been designed to optimize the formulated block-model problem. The authors constructed one shared function from multiple objective functions to perform optimization for this shared function. An evaluate for the proposed approach has been carried out in multiple samples and various situations including dichotomous relations, signed relations, ordinal

and interval valued relations, multiple relations and large network (up to 1600 nodes). The results established the superiority of the proposed solution.

In the second article, Khari and Kumar have been inspired by the collective behavior of finding paths from the colony of food and uses different versions of Hill Climbing Algorithm (HCA) including Stochastic, and Steepest Ascent HCA for the purpose of finding a good optimal solution. The authors proposed a control flow graph at the least cost and time by comparing the two versions of HCA. The proposed algorithm performance has been verified on the basis of three parameters comprising of optimized test cases, the time taken during the optimization process, and the percentage of optimization achieved. The results depicted that the Stochastic HCA has superior average percentage compared to the Steepest Ascent HCA in reducing the number of test cases in order to accomplish the optimization target.

Automatic generation of test data has been the primary focus of software engineering research in recent past. Effective generation of test cases is necessary in software testing in order to perform rigorous testing. For effective test case generation, various techniques have been developed. These techniques were based on several test adequacy criteria including statement coverage and branch coverage. Test suite optimization can save computing resources, for instance, time and memory space. Bio-inspired algorithms have been effectively applied in test suite optimization. Pandey and Banerjee in the third article proposed a novel approach for test suite optimization using the chaotic firefly algorithm. The experimental results established that the firefly convergence toward the optimized landscape has been improved with the chaotic movement of fireflies.

Khairuzzaman and Chaudhury in the fourth article proposed a new technique for multilevel thresholding based on Moth-Flame Optimization (MFO) algorithm. The evaluation of the thresholds has been performed using Kapur's entropy and Otsu's between class variance function. The proposed method has been tested on a set of benchmark test images. Furthermore, the performance of the proposed approach has been compared with the PSO (Particle Swarm Optimization) and BFO (Bacterial Foraging Optimization) based methods. The results proved the superiority of the MFO based multilevel thresholding method compared to the PSO and BFO based methods.

Clustering in wireless sensors networking is another engineering problem to prolong the life of a network with energy consumption. Such problem can be formulated as an optimization problem. In the fifth article, Parwekar and Rodda applied the genetic algorithm for clustering optimization to minimize the communication distance. The cluster overhead and the active and sleep mode of a sensor has been also considered while calculating the fitness function to form the cluster. The proposed approach has been tested for different number of nodes to find the correct solution for the cluster heads selection.

Priyadarshini et al. in the sixth article proposed a hybrid machine learning classifier to design an artificial predictor to classify diabetic and non-diabetic people. This hybrid classifier has been an amalgamation of the K-means algorithm and Gravitational search algorithm (GSA). The GSA has been involved as an optimization technique to compute the best centroids from the two classes of the training dataset, where the positive class indicates diabetic individuals, while the negative class indicates non-diabetic ones. The optimized centroids from GSA have been used as the cluster centers in the K-means algorithm. The integrated proposed approach solved the k-means algorithm associated inherent problem, namely the initial placement of the cluster centers, by using a combined GSA and K-means.

In the seventh article Sivakoti et al. employed the Particle Swarm Optimization (PSO) algorithm for multilayer microwave absorber optimal design over different frequency ranges. Such optimization problem has been interested with determining the optimal number of layers, selection of suitable combination of materials from a predefined database to minimize the overall reflection coefficient. In addition, this optimization problem has need employed to design a low weight electromagnetic absorber, which absorbs the maximum amount of incident electromagnetic energy. Microwave absorbers or radar absorbing materials (RAM) performance has been studied by varying thickness

and number of layers. The results obtained using PSO have been compared with those obtained using the genetic algorithm and the standard RCS computation software.

As guest editors, we hope the covered research work under this special issue is effective and appreciated by the bio-inspired engineering/ readers/researchers. We are thankful to the authors for their imperative research contribution to this issue and their patience during the revision stages done by experts in the editorial board. We take this opportunity to give our sincere special thanks to Prof. Peng-Yeng Yin, Editor-in-chief of the *International Journal of Applied Metaheuristic Computing (IJAMC)*, for all his support, and competence rendered to this special issue.

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