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Editorial

Special issue: Bio-inspired algorithms and Bio-systems

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Nature is a great source of inspiration to provide solutions for complicated problems. Under evolutionary processes, species are forced to develop highly optimized skills for their survival. Some of these behaviors can be used to design algorithms for real-world problems. Bio-inspired algorithms represent a research area that uses computing schemes extracted from natural phenomena or bio-systems. Such schemes provide sufficient information to design high-performance computing approaches and intelligent paradigms with the capacity for solving complicated formulations.

Bio-inspired algorithms and Bio-systems consider as fundamental areas of biology, mathematics, and computer science. With these tools, biologists study natural phenomena to build their models while engineers employ these models as computing schemes for solving complex real-world problems. The objective of this special issue is to collect original research articles as well as review articles that will stimulate the continuing effort on Bio-inspired algorithms and Bio-systems approaches to solve problems in different domains.

The special issue received several high-quality submissions from different countries all over the world. All submitted papers have followed the same standard of peer-reviewing by at least three independent reviewers, just as it is applied to regular submissions to the Mathematical Biosciences and Engineering journal. Due to the limited space, a very short number of papers have been finally included. The primary guideline has been to demonstrate the wide scope of bio-inspired algorithms and their applications to several problems.

The paper authored by *Alejo-Reyes et al.* presents a novel and non-linear model based on bio-inspired schemes for solving the supplier selection and order quantity allocation problem. The model is introduced for minimizing the total cost per time unit, considering ordering, purchasing, inventory, and transportation cost with freight rate discounts. Perfect rate and capacity constraints are also considered in the model. Since bio-inspired algorithms have been successfully applied in supplier selection, and due to the non-linearity of the proposed model, particle swarm optimization (PSO), genetic algorithm (GA), and differential evolution (DE), are implemented as optimizing solvers instead of analytical methods. The model is tested by solving a reference model using PSO, GA, and DE. The performance is evaluated by comparing the solution to the problem against other solutions reported in the literature. Experimental results prove the effectiveness of the model and demonstrate that metaheuristic algorithms can find lower-cost solutions in less time than analytical methods.

Montiel-Moctezuma et al. consider the problem of dynamic combinatorial optimization under the bio-inspired perspective. In their proposal, the performance of a genetic algorithm (GA) is improved through a self-adaptive mechanism to solve dynamic combinatorial problems such as the

3-SAT, One-Max and TSP. They use the genotype-phenotype mapping strategy and probabilistic distributions to define parameters in the algorithm in order to enhance the GA search strategy. Experimental evidence demonstrated that this mechanism improves the capability to adapt algorithms in dynamic environments.

The paper by *Wang et al.* proposes a multi-threshold image segmentation method based on a modified bio-inspired salp swarm algorithm (SSA). Multi-threshold image segmentation method has a good segmentation effect, but the segmentation precision will be affected by the increase of the threshold number. To avoid the above problem, the slap swarm optimization algorithm (SSA) is presented to choose the optimal parameters of the fitting function and we use levy flight to improve the SSA. The solutions are assessed using the Kapur's entropy, Otsu and Renyi entropy fitness function during the optimization operation. The performance of the proposed algorithm is evaluated with several reference images and compared with different group algorithms. The results have been analyzed based on the best fitness values, peak signal to noise ratio (PSNR), and feature similarity index measures (FSIM). The experimental results show that the proposed algorithm outperformed other swarm algorithms.

Li et al. present a multimodal bio-inspired optimization method based on the whale optimization algorithm (WOA). The proposed scheme MMWOA enhances the multimodal search ability of the original WOA by using the niching technique and improves the local search efficiency of WOA by combining the Gaussian sampling technique. The algorithm has been tested on multimodal optimization benchmark functions recommended by CEC'2013 and on a multimodal optimization problem with non-linear constraints. Experimental results indicate that MMWOA has competitive performance compared with other state-of-the-art multimodal optimization algorithms.

Finally, the paper authored by *Peng et al.* presents a modified Dragonfly algorithm (MDA) to determine the optimal combination of different levels of thresholds for segmentation in color images. Chaotic mapping and elite opposition-based learning strategies (EOBL) are used to improve the randomness of the initial population. The hybrid algorithm of Dragonfly Algorithms (DA) and Differential Evolution (DE) is used to balance the two basic stages of optimization: exploration and development. Kapur entropy, minimum cross-entropy and Otsu method are used as fitness functions of image segmentation. The performance of 10 test color images is evaluated and compared with 9 different meta-heuristic algorithms. The results show that the color image segmentation method based on MDA is more effective and accurate than other competitors in average fitness value (AF), standard deviation (STD), peak signal-to-noise ratio (PSNR), structural similarity index (SSIM) and feature similarity index (FSIM). Friedman test and Wilcoxon's rank-sum test are also performed to assess the significant difference between the algorithms.

Acknowledgments

Finally, we would like to express our gratitude to all of the authors for their contributions and the reviewers for their efforts to provide valuable comments and feedback. We hope this special issue offers a comprehensive and timely view of the area of Bio-inspired algorithms and that it will grant stimulation for further research.

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