Preface

The purpose of this volume entitled "Multi-objective Swarm Intelligence: Theoretical Advances and Applications" is to attract a wide range of researchers and readers from all fields of science and engineering performing interdisciplinary research based on swarm intelligence methodologies to optimize intractable problems, which are either in the form of single or multi-objective optimization.

Multi-objective optimization deals with the simultaneous optimization of two or more objectives which are normally conflicting with each other. Since multi-objective optimization problems are relatively common in real-world applications, this area has become a very popular research topic since the 1970s. However, the use of bio-inspired meta-heuristics for solving multi-objective optimization problems started in the mid-1980s and remained popular until the mid-1990s. Nevertheless, the effectiveness of multi-objective evolutionary algorithms has made them very popular in a variety of domains.

Swarm intelligence refers to certain population-based meta-heuristics that are inspired on the behavior of groups of entities (i.e., living beings) interacting locally with each other and with their environment. Such interactions produce an emergent behavior that is modeled in a computer in order to solve problems. The two most popular meta-heuristics within swarm intelligence are particle swarm optimization (which simulates a flock of birds seeking food) and ant colony optimization (which simulates the behavior of colonies of real ants that leave their nest looking for food). These two meta-heuristics have become very popular in the last few years, and have been widely used in a variety of optimization tasks, including some related to data mining and knowledge discovery in databases, bio-informatics, computational finance, social networks, etc. However, such work has been mainly focused on single objective optimization models. Furthermore, it is not feasible to prioritize these objectives a priori. The robust nature and population-based approach of swarm intelligence and their cross-hybridization seem to be good methods for multi-criterion problems. Therefore, we are motivated toward multi-objective swarm intelligence and cross-fertilization among methodologies of swarm intelligence to solve various practical problems. In this volume an empirical and theoretical work on ant colony, particle swarm, bacteria foraging, and artificial bee colony-based optimization has been discussed along with a wide range of applications that are applied in real-world problems.

In the chapter "A Comprehensive Review on Bacteria Foraging Optimization Technique", Selva and Kumar have focused on the behavior of biological bacterial colony followed by the optimization algorithm based on bacterial colony foraging. Further, they explored variations in the components of BFO algorithm (Revised BFO), hybridization of BFO with other Evolutionary Algorithms (Hybrid BFO), and multi-objective BFO. Finally, they have analyzed some applications of BFO algorithm in various domains.

In the chapter "Swarm Intelligence in Multiple and Many Objectives Optimization: A Survey and Topical Study on EEG Signal Analysis", Mishra, Dehuri, and Cho present Swarm Intelligence (SI) methods for optimization of multiple and many objective problems. They have provided the fundamental difference between Multiple and Many Objective Optimization problems. The three forefront swarm intelligence methods, i.e., Ant Colony Optimization (ACO), Particle Swarm Optimization (PSO), and Artificial Bee Colony Optimization (ABC) have been deeply studied to understand their ways of solving multiple and many objective problems distinctly. Finally, they have presented a survey on the study of the behavior of real ants, bird flocks, and honey bees in solving EEG signal analysis.

In the chapter "Comparison of Various Approaches in Multi-objective Particle Swarm Optimization (MOPSO): Empirical Study", Devi, Jagadev, and Dehuri present an empirical study with a comparison of various approaches in Multi-objective Particle Swarm Optimization (MOPSO). They have attempted to analyze these methods, discussing their strengths, and weaknesses. A multi-objective particle swarm optimization algorithm, named dynamic multiple swarms in multi-objective PSO, is compared with other well-known PSO techniques in which the number of swarms is adaptively adjusted throughout the search process via dynamic swarm strategy.

Many optimization problems involve selecting the best subset of solution components. Besides, many other optimization problems can be modeled as a subset problem. The chapter "Binary Ant Colony Optimization for Subset Problems" by Nadia Abd-Alsabour focuses on developing a new framework of Ant Colony Optimization (ACO) for optimization problems that require selecting (subset problems- selecting a subset of items from some larger set subject to certain constraints) rather than ordering (where the order between solutions components is important and the next component to be added to a partial solution is affected by the last added component) with an application to feature selection for regression problems as a representative for subset problems. This is addressed through three points as follows: explaining the main guidelines of developing an ant algorithm, demonstrating different solution representations for subset problems using ACO algorithms, and proposing a binary ant algorithm for feature selection for regression problems.

In the chapter "Ant Colony for Locality Foraging in Image Enhancement", Simone, Gadia, Farup, and Rizzi have presented an ant colony for locality foraging in image enhancement. Further, they have presented a spatial color algorithm called Termite Retinex and the problem of filtering locality in this family of algorithms for image enhancement, inspired by the human vision system. The algorithm is a recent implementation of Retinex with a colony of agents, which uses swarm intelligence to explore the image, determining in this way the locality of its filtering. This results in an unsupervised detail enhancement, dynamic range stretching, color correction, and high dynamic range tone rendering. In the chapter, they describe the characteristic of glocality (glocal = global + local) of image exploration, and after a description of the Retinex spatial color algorithm family, they present the Termite approach and discuss results.

Scheduling is the process of deciding how to commit resources to varieties of possible jobs. It also involves the allocation of resources over a period of time to perform a collection of jobs. Job scheduling is the sequencing of the different operations of a set of jobs in different time intervals to a set of machines. Rani in the chapter "Hybridization of Evolutionary and Swarm Intelligence Techniques for Job Scheduling Problem", uses Hybridization of Evolutionary and Swarm Intelligence Techniques for Job Scheduling Problem. The existing systems have utilized techniques such as Artificial Bee Colony (ABC), Genetic Algorithm (GA), Particle Swarm Optimization (PSO), Ant Colony Optimization (ACO), Simulated Annealing (SA), etc., and hybrid techniques were derived from the combination of these algorithms. These hybrid techniques mostly concentrate on two factors such as the minimization of the makespan and completion time. The performance of these hybrid techniques lacks in the scheduling process because they have not considered efficient factors like (i) turnaround time, (ii) throughput, and (iii) response time during the job scheduling process. The main aim of this work is to provide a better hybrid job scheduling technique by overcoming the problems that exist in the literary works and to minimize the completion and makespan time. The proposed technique considered the efficient factors (i) turnaround time, (ii) throughput, and (iii) response time which were left out in the existing hybrid techniques for job scheduling process. The performance of the proposed hybrid job scheduling technique was analyzed with the existing hybrid techniques. The experimental results proved that the proposed job scheduling technique attained higher accuracy and efficiency than the existing hybrid techniques.

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Satchidananda Dehuri
Alok Kumar Jagadev
Mrutunjaya Panda

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