

# Preface

In many applications, we have to deal with complex optimization problems with complicated constraints. Such problems can be challenging to solve, due to their complexity, nonlinearity and potentially high-dimensionality. These problems can even be NP-hard, and thus require alternative solution methods because conventional methods usually cannot deal with such complex problems. In recent years, nature-inspired metaheuristic algorithms have gained huge popularity because they have demonstrated some promising results in solve tough optimization problems. These metaheuristic algorithms include ant colony optimization, particle swarm optimization, cuckoo search, firefly algorithm, bat algorithm, flower pollination algorithm, bee algorithms and others. There are many reasons for such popularity. In general, these algorithms tend to be flexible, efficient and highly adaptable, and yet easy to implement. The high efficiency of these algorithms makes it possible to apply them to a wide range of problems in diverse applications.

Swarm intelligence is quite a general concept in that multiple agents interact and exchange information, following simple rules. Rather surprisingly, such simple systems can show complex, self-organized behaviour. Though the characteristics of agent interactions may be drawn from different sources of inspiration in nature, algorithmic procedures can be quite simple and flexible, and yet efficient in practice. On the other hand, evolutionary computation is traditionally considered as part of computational intelligence, which concerns optimization with continuous, combinatorial or mixed problems. Algorithms such as genetic algorithms and evolutionary strategy are good examples of evolutionary computation. However, evolutionary computation has broadened its scope and extended to include many areas. Loosely speaking, swarm intelligence is part of the evolutionary computation paradigm, but the interests in swarm intelligence are so overwhelming that swarm intelligence has almost become a field by itself. Here, we will not debate on what the right terminology or fields should be. We discuss both swarm intelligence and evolutionary computation in the broadest sense in this book.

The rapid advances in swarm intelligence and evolutionary computation have resulted in a much richer literature. This timely review volume summarizes the state-of-the-art developments in nature-inspired algorithms and applications with

the emphasis on swarm intelligence and bio-inspired computation. Topics include the analysis and overview of swarm intelligence and evolutionary computation, hybrid metaheuristic algorithms, bat algorithm, discrete cuckoo search, firefly algorithm, particle swarm optimization, and harmony search as well as convergent hybridization. Application case studies have focused on the feature selection by the binary flower pollination algorithm, dehydration of fruits and vegetables by the firefly algorithm and goal programming, job shop scheduling, single row facility layout optimization, training of feed-forward neural networks, damage and stiffness identification, synthesis of cross-ambiguity functions by the bat algorithm, web document clustering, truss analysis, water distribution networks, sustainable building designs and others.

As a timely review, this book can serve as an ideal reference for graduates, lecturers, engineers and researchers in computer science, evolutionary computing, artificial intelligence, machine learning, computational intelligence, data mining, engineering optimization and designs.

I would like to thank our editors, Drs. Thomas Ditzinger and Holger Schaepe, and the staff at Springer for their help and professionalism. Last but not least, I thank my family for the help and support.

London, September 2014

Xin-She Yang

Recent Advances in Swarm Intelligence and  
Evolutionary Computation

Yang, X.-S. (Ed.)

2015, XI, 300 p. 94 illus., 15 illus. in color., Hardcover

ISBN: 978-3-319-13825-1