Nadia Nedjah, Leandro dos Santos Coelho, and Luiza de Macedo de Mourelle (Eds.)

Multi-Objective Swarm Intelligent Systems

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Multi-Objective Swarm Intelligent Systems

Theory & Experiences

Springer

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Preface

Recently, a new class of heuristic techniques, the swarm intelligence has emerged. In this context, more recently, biologists and computer scientists in the field of "artificial life" have been turning to insects for ideas that can be used for heuristics. Many aspects of the collective activities of social insects, such as foraging of ants, birds flocking and fish schooling are self-organizing, meaning that complex group behavior emerges from the interactions of individuals who exhibit simple behaviors by themselves.

Swarm intelligence is an innovative computational way to solving hard problems. This discipline is mostly inspired by the behavior of ant colonies, bird flocks and fish schools and other biological creatures. In general, this is done by mimicking the behavior of these swarms.

Swarm intelligence is an emerging research area with similar population and evolution characteristics to those of genetic algorithms. However, it differentiates in emphasizing the cooperative behavior among group members. Swarm intelligence is used to solve optimization and cooperative problems among intelligent agents, mainly in artificial network training, cooperative and/or decentralized control, operational research, power systems, electro-magnetics device design, mobile robotics, and others. The most well-known representatives of swarm intelligence in optimization problems are: the food-searching behavior of ants, particle swarm optimization, and bacterial colonies.

Real-world engineering problems often require concurrent optimization of several design objectives, which are conflicting in most of the cases. Such an optimization is generally called multi-objective or multi-criterion optimization. In this context, the development of improvements for swarm intelligence methods to multi-objective problems is an emergent research area.

In Chapter 1, which is entitled *Multi-objective Gaussian Particle Swarm Approach Applied to Multi-Loop PI Controller Tuning of a Quadruple-Tank System*, the authors propose a multi-objective particle swarm optimization approach inspired from some previous related work. The approach updates the velocity vector using the Gaussian distribution, called MGPSO, to solve the multi-objective optimization of the multi-loop Proportional-Integral control tuning.

In Chapter 2, which is entitled *A Non-Ordered Rule Induction Algorithm Through Multi-Objective Particle Swarm Optimization: Issues and Applications*, the authors propose a new approach, called MOPSO-N, validate its efficiency. They also describe the application of MOPSO-N in the Software Engineering domain.

In Chapter 3, which is entitled *Use of Multiobjective Evolutionary Algorithms in Water Resources Engineering*, the authors investigate the efficiency of multi-objective particle swarm optimizaton in Water Resources Engineering.

In Chapter 4, which is entitled *Micro-MOPSO: A Multi-Objective Particle Swarm Optimizer that Uses a Very Small Population Size*, the author present a multi-objective evolutionary algorithm (MOEA) based on the heuristic called "particle swarm optimization" (PSO). This multi-objective particle swarm optimizer (MOPSO) is characterized for using a very small population size, which allows it to require a very low number of objective function evaluations (only 3000 per run) to produce reasonably good approximations of the Pareto front of problems of moderate dimensionality.

In Chapter 5, which is entitled *Dynamic Multi-objective Optimisation using PSO*, the author introduce the usage of the vector evaluated particle swarm optimiser (VEPSO) to solve DMOOPs, wherein every objective is solved by one swarm and the swarms share knowledge amongst each other about the objective that it is solving.

In Chapter 6, which is entitled *Meta-PSO for Multi-Objective EM Problems*, the authors investigate some variations over the standard PSO algorithm, referred to as Meta-PSO, aiming at enhancing the global search capability, and, therefore, improving the algorithm convergence.

In Chapter 7, which is entitled *Multi-Objective Wavelet-Based Pixel-Level Image Fusion Using Multi-Objective Constriction Particle Swarm Optimization*, the authors present a new methodology of multi-objective pixel-level image fusion based on discrete wavelet transform and design an algorithm of multi-objective constriction particle swarm optimization (MOCPSO).

In Chapter 8, which is entitled *Multi-objective Damage Identification Using Particle Swarm Optimization Techniques*, the authors present a particle swarm optimization-based strategies for multi-objective structural damage identification. Different variations of the conventional PSO based on evolutionary concepts are implemented for detecting the damage of a structure in a multi-objective framework.

The editors are very much grateful to the authors of this volume and to the reviewers for their tremendous service by critically reviewing the chapters. The editors would like also to thank Prof. Janusz Kacprzyk, the editor-in-chief of the Studies in Computational Intelligence Book Series and Dr. Thomas Ditzinger, Springer Verlag, Germany for the editorial assistance and excellent cooperative collaboration to produce this important scientific work.

We hope that the reader will share our excitement to present this volume on **Multi-Objective Swarm Intelligent Systems** and will find it useful.

August 2009

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