Editorial
Special Issue: Multi-Objective Optimization

Real-world engineering problems often require concurrent optimisation of several design objectives, which are conflicting in most of the cases. Such an optimisation is generally called multi-objective or multi-criterion optimisation. The area of research that applies evolutionary methodologies to multi-objective optimisation is of special and growing interest. It brings a solution to many yet-opened real-world problems and questions.

Generally, multi-objective engineering problems have no single optimal design, but several solutions of equal efficiency allowing different trade-offs. Decision maker's preferences are normally used to select the most adequate design. Such preferences may be dictated before or after the optimisation takes place. They may also be introduced interactively at different levels of the optimisation process. Multi-objective optimisation methods can be subdivided into classical and evolutionary. The classical methods usually aim at a single solution while the evolutionary methods provide target a whole set of so-called Pareto-optimal solutions.

The aim of this special issue of *the International Journal of Computers, Signals and Systems* is to provide a representation of the new trends of evolutionary multi-objective optimisation research area. It reports many innovative designs yield by the application of such optimisation methods.

Five papers were selected through a peer review thanks to the help of internationally known specialist in the area of multi-objective optimisation. In the following, we give a brief overview of these papers.

In the first paper, which is entitled "Directed Multi-Objective Optimisation," M. Brown and R. E. Smith develop a local framework for multi-objective problems with reasonably smooth objectives by geometrically analyzing the multi-objective concepts of descent, diversity and convergence/optimality. They show that locally optimal, multi-objective descent direction can be calculated that maximally reduce all the objectives and a local sub-space also exists that is a basis for diversity updates. Furthermore, the authors validate the proposed theory using some test examples.

In the second paper, which is entitled "A Multi-Objective Evolutionary Algorithm Using Neural Networks to Approximate Fitness Evaluations," A. Gaspar-Cunha and A. Vieira propose two different methods to accelerate the search of a Multi-Objective Evolutionary Algorithm (MOEA) using Artificial Neural Networks: One uses artificial neural networks to approximate the fitness of the solutions alternated with the real fitness evaluation and the other used neural networks as a local search strategy by defining new better solutions from the precedent generation. The authors prove that these methods can substantially reduce the number of fitness evaluations on computational expensive problems while not compromise the good search capabilities of MOEA. They establish efficiency of the methods using several benchmark functions as well on a real multi-optimization problem of polymer extrusion.

In the third paper, which is entitled "Evolving Optimal Multi-Objective Hardware Using Strength Pareto Evolutionary Algorithms," N. Nedjah and L. M. Mourelle focus on engineering Pareto-optimal digital circuits given the expected input/output behaviour with a minimal design effort. The design objectives to be minimised are: hardware area, response time and power consumption. The authors claim that this is novel application of multi-objective optimisation to circuit design. They show that the evolutionary hardware is far better with respect to all objectives than those designed using traditional methods.

In the fourth paper, which is entitled "Multiple Objective Optimisation Genetic Algorithms for Path Planning in Autonomous Mobile Robots," O. Castillo and L. Trujillo generate valid trajectories for Holonomic Robots to move from a starting position to a destination across a terrain with obstacles and dangerous grounds that the Robot must evade. The authors do so using the Multi-Objective Genetic Algorithm MOGA. They show that single-objective as well as multi-objective genetic algorithms are effective tools for solving the point-to-point path planning problem.

In the fifth paper, which is entitled "Application of Evolutionary Algorithms in Supply Chain Management," M. H. Lim and Y. L. Xu consider the problem of managing a distribution network for replenishing the supply of fuel to refuelling stations located all over the island. The authors design a multi-objective evolutionary algorithm to generate a set of routes for a fleet of fuel trucks. The trucks are dispatched according to a pre-specified plan to replenish the supply of the various refuelling stations subject to several dynamic constraints.

We would like to thank the ad-hoc reviewers that helped with the review process of the papers submitted to this special issue.

Sincerely,

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