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Evolutionary Multi-Criterion Optimization

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Proceedings



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Preface

Multi-criterion optimization refers to optimization problems with two or more objectives expressing conflicting goals that are formulated within a mathematical programming framework. The problems addressed may involve linear or nonlinear objective functions and/or constraints, continuous or discrete variables, and may or may not be affected by uncertainty in the data. This branch of multiple criteria decision making (MCDM) finds application in numerous domains: engineering design, health, transportation, telecommunications, bioinformatics, etc.

The concept of a unique optimal solution does not apply as soon as multiple objectives are optimized simultaneously. The models and methods introduced in multi-criterion optimization deal with the concept of a set of efficient (also called Pareto optimal) solutions. Efficient solutions imply trade-offs between the different criteria. The computation of the efficient solution set may be hard when the size of the problem is large, when the problem is computationally complex, when the data are not crisp. It is then often impossible to guarantee the computation of exact solutions. In that case, approximate solutions, i.e., sub-optimal solutions computed with limited and controlled resources, such as available time, are of interest. This is the domain of multi-objective metaheuristics, of which evolutionary multi-criterion optimization (EMO) is definitely the most prominent representative. The success of EMO is due to the simplicity of its concepts and the generality of its methods, and is clearly expressed by the many impressive success stories reported in the literature.

Research activities in EMO have boomed since the mid-1990s. Three generations of work are identifiable throughout the years. In the first generation, research focused on the design of efficient algorithmic methods for the approximation of efficient solutions. The second generation dealt with the problem of measuring the quality of the approximations generated by the algorithms. The current generation stresses the hybridization with other currents of optimization. “Hot” questions concern the integration of a decision maker (interactivity, preferences), the robustness of the generated solutions, and the coupling with other optimization approaches (operations research, constraint programming, other metaheuristics). Research in the area of EMO is evolving very fast, and continuously investigates new challenging open questions in order to enlarge and refine its position of useful technology for multi-criterion optimization. Today EMO algorithms are recognized as being among the most valuable and promising methods for tackling complex and diverse multi-criterion optimization problems.

To capitalize on, and promote exchanges within, the growing community of researchers involved in evolutionary multi-criterion optimization, an international conference series devoted to EMO was launched in 2001. This conference brings together researchers and practitioners from different disciplines of computer science, operations research, engineering optimization, mathematical

programming and multi-criteria analysis. Theoretical results and algorithmic developments in the field of EMO are covered, including practice and applications of EMO in real-life situations. After Zürich (Switzerland) in 2001, Faro (Portugal) in 2003, Guanajuato (Mexico) in 2005 and Matsushima-Sendai (Japan) in 2007, Nantes (France) hosted the 5th International Conference on Evolutionary Multi-Criterion Optimization (EMO 2009). The conference took place at the Faculty of Science of the University of Nantes during April 7-10, 2009.

To emphasize the current generation of EMO research, the subtitle of the conference was “Where Optimization Technologies Meet Evolutionary Multi-Criterion Optimization”. The conference was structured around invited speakers (tutorial sessions, keynote sessions, industrial session) and selected presentations (oral sessions and poster session). The EMO 2009 scientific program included five invited talks given by Denis Bouyssou (France) on “Choice and Preferences,” Kathrin Klamroth (Germany) on “Discrete Multiobjective Optimization,” Manual Laguna (USA) on “Scatter Search and Path-Relinking,” Thomas Stützle (Belgium) on “Ant Colony Optimization,” and Pascal Van Hentenryck (USA) on “Constraint Programming.” The selection of contributed papers was based on full-paper submissions, rigorously refereed by at least three members of the International Program Committee. The EMO 2009 International Program Committee was composed of 118 international well-known researchers from 25 countries. This volume includes the 39 research papers that were selected for presentation at the conference, from the 72 submissions received. The papers published in the volume represent the most recent developments on evolutionary multi-criterion optimization, and cover a large spectrum of current research topics: applications, algorithm development, theoretical analysis, performance analysis and comparison, alternative methods, MCDM, many objectives, uncertainty and noise, and the interface between EMO and MCDA.

We would like to express our appreciation to the keynote, tutorial and industrial speakers for accepting our invitation. We also thank all the authors who submitted their work to EMO 2009. Our sincerest gratitude goes to the members of the International Program Committee for the considerable work they have invested in the reviewing process and for their contribution to making this volume an up-to-date reference in the field of evolutionary multi-criterion optimization. The organizers are especially grateful to all the sponsors for financial support, and to the members of the Local Organizing Committee for their investment in the preparation of the conference, in particular, Valérie Coutand, the conference secretary.

April 2009

Matthias Ehrgott
Carlos M. Fonseca
Xavier Gandibleux
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Marc Sevaux

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EMO 2009 was organized by the Faculté des Sciences of the Université de Nantes in cooperation with Ecole Centrale de Nantes, Ecole des Mines de Nantes, Université d'Angers and Université de Bretagne-Sud.

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