# Preface

Evolutionary Computation (EC) involves the study of problem solving and optimization techniques inspired by principles of natural evolution and genetics. EC has been able to draw the attention of an increasing number of researchers and practitioners in several fields. Evolutionary algorithms have in particular been shown to be effective for difficult combinatorial optimization problems appearing in various industrial, economic, and scientific domains.

This volume contains the proceedings of EvoCOP 2004, the 4th European Conference on Evolutionary Computation in Combinatorial Optimization. It was held in Coimbra, Portugal, on April 5–7, 2004, jointly with EuroGP 2004, the 7th European Conference on Genetic Programming, and EvoWorkshops 2004, which consisted of the following six individual workshops: EvoBIO, the 2nd European Workshop on Evolutionary Bioinformatics; EvoCOMNET, the 1st European Workshop on Evolutionary Computation in Communications, Networks, and Connected Systems; EvoHOT, the 1st European Workshop on Hardware Optimisation; EvoIASP, the 6th European Workshop on Evolutionary Computation in Image Analysis and Signal Processing; EvoMUSART, the 2nd European Workshop on Evolutionary Music and Art; and EvoSTOC, the 1st European Workshop on Evolutionary Algorithms in Stochastic and Dynamic Environments.

EvoNet, the European Network of Excellence in Evolutionary Computing, organized its first events in 1998 as a collection of workshops that dealt with both theoretical and application-oriented aspects of EC. EuroGP, one of these workshops, soon became the main European conference dedicated to Genetic Programming. EvoCOP, held annually as a workshop since 2001, followed EuroGP. Due to its continuous growth in the past, EvoCOP became a conference in 2004, and it is now the premier European event focusing on evolutionary computation in combinatorial optimization. The events gave researchers and practitioners an excellent opportunity to present their latest research and to discuss current developments and applications, besides stimulating closer future interaction between members of this scientific community. Accepted papers of previous EvoCOP events were also published by Springer in the series Lecture Notes in Computer Science (LNCS Volumes 2037, 2279, and 2611).

EvoCOP 2004 covers evolutionary algorithms as well as related metaheuristics like memetic algorithms, ant colony optimization, and scatter search. The papers deal with representations, operators, search spaces, adaptation, comparison of algorithms, hybridization of different methods, and theory. The list of studied combinatorial optimization problems includes on the one hand classical academic problems such as graph coloring, network design, cutting, packing, scheduling, timetabling, the traveling salesperson problem, and vehicle routing, and on the other hand specific real-world applications.

The success of EvoCOP, so far the only international series of events specifically dedicated to the application of evolutionary computation and related methods to combinatorial optimization problems, is documented by a steadily growing number of submissions; see the table below. EvoCOP 2004 is the largest event of its series. A double-blind reviewing process made a strong selection among the submitted papers, resulting in an acceptance rate of 26.7%. All accepted papers were presented orally at the conference and are included in this proceedings volume. We would like to give credit to the members of the program committee, to whom we are very grateful for their quick and thorough work.

| EvoCOP | submitted | accepted | acceptance ratio |
|--------|-----------|----------|------------------|
| 2001 | 31 | 23 | 74.2% |
| 2002 | 32 | 18 | 56.3% |
| 2003 | 39 | 19 | 48.7% |
| 2004 | 86 | 23 | 26.7% |

EvoCOP 2004 was sponsored, for the last time, by EvoNet, whose activity as an EU-funded project has come to an end with the organization of this year's events. However, the figures reported above show that EvoCOP, as well as EuroGP and the EvoWorkshops, have reached a degree of maturity and scientific prestige that will allow the activity promoted by EvoNet during the last six years to go on, and presumably further expand in the years to come.

The organization of the event was made possible thanks to the active participation of several members of EvoNet. In particular, we want to thank Jennifer Willies, EvoNet's administrator, for her tremendous efforts.

April 2004

Jens Gottlieb
Günther R. Raidl

# Organization

EvoCOP 2004 was organized jointly with EuroGP 2004 and the EvoWorkshops 2004.

## Organizing Committee

Chairs:         Jens Gottlieb, SAP AG, Germany

                Günther R. Raidl, Vienna University of Technology, Austria

Local Chair:  Ernesto Costa, University of Coimbra, Portugal

## Program Committee

Hernan Aguirre, Shinshu University, Japan
Jarmo Alander, University of Vaasa, Finland
M. Emin Aydin, University of the West of England, UK
Jean Berger, Defence Research and Development Canada, Canada
Christian Bierwirth, University Halle-Wittenberg, Germany
Jürgen Branke, University of Karlsruhe, Germany
Edmund Burke, University of Nottingham, UK
David W. Corne, University of Exeter, UK
Ernesto Costa, University of Coimbra, Portugal
Carlos Cotta, University of Malaga, Spain
Peter Cowling, University of Bradford, UK
Bart Craenen, Vrije Universiteit, Amsterdam, The Netherlands
David Davis, NuTech Solutions, Inc., MA, USA
Marco Dorigo, Université Libre de Bruxelles, Belgium
Karl Dörner, University of Vienna, Austria
Anton V. Eremeev, Omsk Branch of the Sobolev Institute of Mathematics, Russia
David Fogel, Natural Selection, Inc., CA, USA
Bernd Freisleben, University of Marburg, Germany
Jens Gottlieb, SAP AG, Germany
Michael Guntsch, University of Karlsruhe, Germany
Jin-Kao Hao, University of Angers, France
Emma Hart, Napier University, UK
Jano van Hemert, CWI, The Netherlands
Jörg Homberger, Stuttgart University of Cooperative Education, Germany
Li Hui, University of Essex, UK
Mikkel T. Jensen, University of Aarhus, Denmark
Bryant A. Julstrom, St. Cloud State University, MN, USA

Graham Kendall, University of Nottingham, UK
Dimitri Knjazew, SAP AG, Germany
Joshua D. Knowles, UMIST, UK
Gabriele Koller, Vienna University of Technology, Austria
Mario Köppen, FhG IPK, Germany
Jozef Kratica, Serbian Academy of Sciences and Arts, Yugoslavia
Ivana Ljubić, Vienna University of Technology, Austria
Elena Marchiori, Free University Amsterdam, The Netherlands
Dirk Mattfeld, University of Hamburg, Germany
Helmut Mayer, University of Salzburg, Austria
Daniel Merkle, University of Leipzig, Germany
Peter Merz, University of Kaiserslautern, Germany
Martin Middendorf, University of Leipzig, Germany
Christine L. Mumford, Cardiff University, UK
Francisco J.B. Pereira, University of Coimbra, Portugal
Adam Prügel-Bennett, University of Southampton, UK
Jakob Puchinger, Vienna University of Technology, Austria
Günther R. Raidl, Vienna University of Technology, Austria
Marcus Randall, Bond University, Australia
Colin Reeves, Coventry University, UK
Marc Reimann, Swiss Federal Institute of Technology, Zurich, Switzerland
Claudio Rossi, University Carlos III, Madrid, Spain
Franz Rothlauf, University of Mannheim, Germany
Andreas Sandner, SAP AG, Germany
Marc Schoenauer, INRIA, France
Christine Solnon, University of Lyon I, France
Giovanni Squillero, Politecnico di Torino, Italy
Thomas Stützle, Darmstadt University of Technology, Germany
El-ghazali Talbi, Laboratoire d'Informatique Fondamentale de Lille, France
Ingo Wegener, University of Dortmund, Germany
Darrell Whitley, Colorado State University, CO, USA
Yong Xu, University of Birmingham, UK
Takeshi Yamada, NTT Communication Science Laboratories, Japan

## Sponsoring Institutions

– EvoNet, the Network of Excellence in Evolutionary Computing
– University of Coimbra, Coimbra, Portugal