Lecture Notes in Computer Science 3449

Commenced Publication in 1973
Founding and Former Series Editors:
Gerhard Goos, Juris Hartmanis, and Jan van Leeuwen

Editorial Board

David Hutchison
Lancaster University, UK

Takeo Kanade
Carnegie Mellon University, Pittsburgh, PA, USA

Josef Kittler
University of Surrey, Guildford, UK

Jon M. Kleinberg
Cornell University, Ithaca, NY, USA

Friedemann Mattern
ETH Zurich, Switzerland

John C. Mitchell
Stanford University, CA, USA

Moni Naor
Weizmann Institute of Science, Rehovot, Israel

Oscar Nierstrasz
University of Bern, Switzerland

C. Pandu Rangan
Indian Institute of Technology, Madras, India

Bernhard Steffen
University of Dortmund, Germany

Madhu Sudan
Massachusetts Institute of Technology, MA, USA

Demetri Terzopoulos
New York University, NY, USA

Doug Tygar
University of California, Berkeley, CA, USA

Moshe Y. Vardi
Rice University, Houston, TX, USA

Gerhard Weikum
Max-Planck Institute of Computer Science, Saarbruecken, Germany

Franz Rothlauf et al. (Eds.)

Applications of Evolutionary Computing

EvoWorkshops 2005: EvoBIO, EvoCOMNET, EvoHOT, EvoIASP, EvoMUSART, and EvoSTOC
Lausanne, Switzerland, March 30 – April 1, 2005
Proceedings

Springer

Volume Editor
see next page

Cover illustration: *Triangular Urchin*, by Chaps (www.cetoine.com).
Chaps has obtained an MSc in Physics at the Swiss Federal Institute of Technology. He is the developer of the ArtiE-Fract software that was used to create *Triangular Urchin*. *Triangular Urchin* (an Iterated Functions System of 2 polar functions) emerged from an urchin structure after a few generations using ArtiE-Fract. The evolutionary process was only based on soft mutations, some of them directly induced by the author.

Library of Congress Control Number: 2005922824

CR Subject Classification (1998): F.1, D.1, B, C.2, J.3, I.4, J.5

ISSN 0302-9743
ISBN-10 3-540-25396-3 Springer Berlin Heidelberg New York
ISBN-13 978-3-540-25396-9 Springer Berlin Heidelberg New York

This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, re-use of illustrations, recitation, broadcasting, reproduction on microfilms or in any other way, and storage in data banks. Duplication of this publication or parts thereof is permitted only under the provisions of the German Copyright Law of September 9, 1965, in its current version, and permission for use must always be obtained from Springer. Violations are liable to prosecution under the German Copyright Law.

Springer is a part of Springer Science+Business Media

springeronline.com

© Springer-Verlag Berlin Heidelberg 2005
Printed in Germany

Typesetting: Camera-ready by author, data conversion by Scientific Publishing Services, Chennai, India
Printed on acid-free paper SPIN: 11402169 06/3142 5 4 3 2 1 0

Volume Editors

Franz Rothlauf
Dept. of Business Administration and
Information Systems
University of Mannheim
Schloss, 68131 Mannheim, Germany
rothlauf@uni-mannheim.de

Jürgen Branke
Institute AIFB
University of Karlsruhe
76128 Karlsruhe, Germany
branke@aifb.uni-karlsruhe.de

Stefano Cagnoni
Dept. of Computer Engineering
University of Parma
Parco Area delle Scienze 181/a
43100 Parma, Italy
cagnoni@ce.unipr.it

David W. Corne
Department of Computer Science
University of Exeter
North Park Road
Exeter EX4 4QF, UK
d.w.corne@ex.ac.uk

Rolf Drechsler
Institute of Computer Science
University of Bremen
28359 Bremen, Germany
drechsle@informatik.uni-bremen.de

Yaochu Jin
Honda Research Institute Europe
Carl-Legien-Str.30
63073 Offenbach/Main, Germany
yaochu.jin@honda-ri.de

Penousal Machado
Dep. de Engenharia Informática
University of Coimbra
Polo II, 3030 Coimbra, Portugal
machado@dei.uc.pt

Elena Marchiori
Dept. of Mathematics and
Computer Science
Free University of Amsterdam
de Boelelaan 1081a
1081 HV, Amsterdam,
The Netherlands
elena@cs.vu.nl

Juan Romero
Facultad de Informatica
University of A Coruña
A Coruña, CP 15071, Spain
jj@udc.es

George D. Smith
School of Computing Sciences
University of East Anglia
UEA Norwich
Norwich NR4 7TJ, UK
gds@sys.uea.ac.uk

Giovanni Squillero
Dip. di Automatica e Informatica
Politecnico di Torino
Corso Duca degli Abruzzi 24
10129 Torino, Italy
squillero@polito.it

Preface

Evolutionary computation (EC) techniques are efficient nature-inspired planning and optimization methods based on the principles of natural evolution and genetics. Due to their efficiency and the simple underlying principles, these methods can be used for a large number of problems in the context of problem solving, optimization, and machine learning. A large and continuously increasing number of researchers and practitioners make use of EC techniques in many application domains. The book at hand presents a careful selection of relevant EC applications combined with thorough examinations of techniques for a successful application of EC. The presented papers illustrate the current state of the art in the application of EC and should help and inspire researchers and practitioners to develop efficient EC methods for design and problem solving.

All papers in this book were presented during EvoWorkshops 2005, which was a varying collection of workshops on application-oriented aspects of EC. Since 1999, the format of the EvoWorkshops has proved to be very successful and well representative of the advances in the application of EC. Consequently, over the last few years, EvoWorkshops has become one of the major events addressing the application of EC. In contrast to other large conferences in the EC field, the EvoWorkshops focus solely on application aspects of EC and are an important link between EC research and the application of EC in a large variety of different domains. The EvoWorkshops are combined with EuroGP, the main European event dedicated to genetic programming, and EvoCOP, which has become the main European conference on EC in combinatorial optimization. The proceedings for both events, EuroGP and EvoCOP, are also available in the LNCS series (numbers 3447 and 3448).

EvoWorkshops 2005, of which this volume contains the proceedings, was held in beautiful Lausanne, Switzerland, on March 30–April 1, 2005, jointly with EuroGP 2005 and EvoCOP 2005. EvoWorkshops 2005 consisted of the following individual workshops:

- *EvoBIO*, the Third European Workshop on Evolutionary Bioinformatics,
- *EvoCOMNET*, the Second European Workshop on Evolutionary Computation in Communications, Networks, and Connected Systems,
- *EvoHOT*, the Second European Workshop on Hardware Optimization,
- *EvoIASP*, the Eighth European Workshop on Evolutionary Computation in Image Analysis and Signal Processing,
- *EvoMUSART*, the Third European Workshop on Evolutionary Music and Art, and
- *EvoSTOC*, the Second European Workshop on Evolutionary Algorithms in Stochastic and Dynamic Environments.

EvoBIO was concerned with the exploitation of EC and related techniques in bioinformatics and computational biology. For analyzing and understanding biological data, EC plays an increasingly important role in pharmaceuticals, biotechnology, and associated industries, as well as in scientific discovery.

EvoCOMNET addressed the application of EC techniques to problems in communications, networks, and connected systems. New communication technologies, the creation of interconnected communication and information networks such as the Internet, new types of interpersonal and interorganizational communication, and the integration and interconnection of production centers and industries are the driving forces on the road towards a connected, networked society. EC techniques are important tools for facing these challenges.

EvoHOT highlighted the latest developments in the field of EC applications to hardware and design optimization. This includes various aspects like the design of electrical and digital circuits, the solving of classical hardware optimization problems like VLSI floorplanning, the application of EC to antenna array synthesis, or the use of ant colony optimization as a hardware-oriented metaheuristic.

EvoIASP, which was the first international event solely dedicated to the applications of EC to image analysis and signal processing, has been a traditional meeting since 1999. This year it addressed topics ranging from solutions for problems in the context of image and signal processing to the adaptive learning of human vocalization in robotics, and the design of multidimensional filters.

EvoMUSART focused on the use of EC techniques for the development of creative systems. There is a growing interest in the application of these techniques in fields such as art, music, architecture and design. The goal of EvoMUSART was to bring together researchers who use EC in this context, providing an opportunity to promote, present and discuss the latest work in the area, fostering its further developments and collaboration among researchers.

EvoSTOC addressed the application of EC in stochastic environments. This includes optimization problems with noisy and approximated fitness functions that are changing over time, the treatment of noise, and the search for robust solutions. These topics recently gained increasing attention in the EC community, and EvoSTOC was the first workshop that provided a platform to present and discuss the latest research in this field.

EvoWorkshops 2005 continued the tradition of providing researchers in these fields, as well as people from industry, students, and interested newcomers, with an opportunity to present new results, discuss current developments and applications, or just become acquainted with the world of EC, besides fostering closer future interaction between members of all scientific communities that may benefit from EC techniques.

This year, EvoWorkshops had the highest number of submissions ever. The number of submissions increased from 123 in 2004 to 143 in 2005. Therefore, EvoWorkshops introduced a new presentation format and accepted a limited number of posters with a reduced number of pages (six pages). In contrast to regular papers, which were presented orally, the posters were presented and discussed in a special poster session during the workshops. The acceptance rate

of 39.1% for EvoWorkshops is an indicator of the high quality of the papers presented at the workshops and included in these proceedings. The following table gives some numbers for the different workshops (accepted posters are in parentheses). Of further importance for the statistics is the acceptance rate of the EvoWorkshops 2004, which was 44.7%.

Workshop	submitted	accepted	acceptance ratio
EvoBIO 2005	32	13	40.6%
EvoCOMNET 2005	22	5	22.7%
EvoHOT 2005	11	7	63.6%
EvoIASP 2005	37	17	45.9%
EvoMUSART 2005	29	10(6)	34.5%
EvoSTOC 2005	12	4(4)	33.3%
Total	143	56(10)	39.1%

We would like to thank all members of the program committees for their quick and thorough work. Furthermore, we would like to acknowledge the support from the University of Lausanne, which provided a great place to run a conference, and from EvoNet, the European Network of Excellence in Evolutionary Computing. The success of EvoWorkshops 2005 shows that the EvoWorkshops, as well as EuroGP and EvoCOP, have reached a degree of maturity and scientific prestige that will allow them to continue their success even without the active support from EvoNet. Over the years, the EvoWorkshops have become major EC events that have been important not only for Europeans but have also attracted large numbers of international EC researchers.

Finally, we want to say a special thanks to everybody who was involved in the preparation of the event. Special thanks are due to Jennifer Willies, whose work and support is a great and invaluable help for scientists who are planning to organize an international conference, and to the local organizers Marco Tomassini, Mario Giacobini, Leonardo Vanneschi, Leslie Luth and Denis Rochat. Without their hard work and continuous support, it would not have been possible to be in such a nice place and to have such a great conference.

April 2005

Franz Rothlauf
David W. Corne
Penousal Machado
George D. Smith

Jürgen Branke
Rolf Drechsler
Elena Marchior
Giovanni Squillero

Stefano Cagnoni
Yaochu Jin
Juan Romero

Organization

EvoWorkshops 2005 was jointly organized with EuroGP 2005 and EvoCOP 2005.

Organizing Committee

EvoWorkshops chair	Franz Rothlauf, University of Mannheim, Germany
Local chair	Marco Tomassini, University of Lausanne, Switzerland
Publicity chair	Jano van Hemert, Napier University, Edinburgh, UK
EvoBIO co-chairs	David W. Corne, University of Exeter, UK
	Elena Marchiori, Free University Amsterdam, The Netherlands
EvoCOMNET co-chairs	Franz Rothlauf, University of Mannheim, Germany
	George D. Smith, University of East Anglia, UK
EvoHOT co-chairs	Giovanni Squillero, Politecnico di Torino, Italy
	Rolf Drechsler, University of Bremen, Germany
EvoIASP chair	Stefano Cagnoni, University of Parma, Italy
EvoMUSART co-chairs	Juan Romero, University of A Coruña, Spain
	Penousal Machado, University of Coimbra, Portugal
EvoSTOC co-chairs	Jürgen Branke, University of Karlsruhe, Germany
	Yaochu Jin, Honda Research Institute Europe, Germany

Program Committees

EvoBIO Program Committee

Francisco J. Azuaje, Ireland
Jesus S. Aguilar-Ruiz, University of Seville, Spain
Wolfgang Banzhaf, Memorial University of Newfoundland, Canada
Jacek Blazewicz, Institute of Computing Science, Poznan, Poland
David W. Corne, University of Exeter, UK
Carlos Cotta-Porras, University of Malaga, Spain
Alfredo Ferro, University of Catania, Italy
Bogdan Filipic, Jozef Stefan Institute, Ljubljana, Slovenia
David Fogel, Natural Selection, Inc., USA
Gary B. Fogel, Natural Selection, Inc., USA

James Foster, University of Idaho, USA
Alex Freitas, University of Kent, UK
Rosalba Giugno, University of Catania, Italy
Jin-Kao Hao, LERIA, Université d'Angers, France
Jaap Heringa, Free University Amsterdam, The Netherlands
Visakan Kadirkamanathan, University of Sheffield, UK
Antoine van Kampen, AMC University of Amsterdam, The Netherlands
W.B. Langdon, UCL, UK
Bob MacCallum, Stockholm University, Sweden
Elena Marchiori, Vrije Universiteit Amsterdam, The Netherlands
Brian Mayoh, Aarhus University, Denmark
Andrew C.R. Martin, University of Reading, UK
Jason H. Moore, Vanderbilt University Medical Center, USA
Pablo Moscato, University of Newcastle, Australia
Ajit Narayanan, University of Exeter, UK
Jagath C. Rajapakse, Technology University, Singapore
Jon Rowe, University of Birmingham, UK
Jem Rowland, University of Wales, Aberystwyth, UK
Vic J. Rayward-Smith, University of East Anglia, UK
El-ghazali Talbi, Laboratoire d'Informatique Fondamentale de Lille, France
Eckart Zitzler, Swiss Federal Institute of Technology, Switzerland

EvoCOMNET Program Committee

Stuart Allen, Cardiff University, UK
Alexandre Caminada, France Télécom R&D, France and
Université de Technologie Belfort-Montbéliard, France
Jin-Kao Hao, University of Angers, France
Bryant Julstrom, St. Cloud State University, USA
Geoff McKeown, UEA Norwich, UK
Günther R. Raidl, Vienna University of Technology, Austria
Franz Rothlauf, University of Mannheim, Germany
Giovanni Squillero, Politecnico di Torino, Italy
George D. Smith, University of East Anglia, UK
Andrew Tuson, City University, London, UK

EvoHOT Program Committee

Gabriella Kokai, Friedrich-Alexander Universität Erlangen, Germany
Ernesto Sanchez, Politecnico di Torino, Italy
Lukas Sekanina, Brno University of Technology, Czech Republic
George Smith, School of Information Systems, UK
Tan Kay Chen, National University of Singapore, Singapore
Luca Sterpone, Politecnico di Torino, Italy
Massimo Violante, Politecnico di Torino, Italy

EvoIASP Program Committee

Giovanni Adorni, University of Genoa, Italy
Lucia Ballerini, Sweden
Bir Bhanu, University of California, Riverside, USA
Dario Bianchi, University of Parma, Italy
Leonardo Bocchi, University of Florence, Italy
Alberto Broggi, University of Parma, Italy
Stefano Cagnoni, University of Parma, Italy
Ela Claridge, University of Birmingham, UK
Ernesto Costa, University of Coimbra, Portugal
Laura Dipietro, Massachusetts Institute of Technology, USA
Marc Ebner, University of Würzburg, Germany
Terry Fogarty, South Bank University, UK
Daniel Howard, QinetiQ, UK
Mario Koeppen, FhG IPK Berlin, Germany
Evelyne Lutton, INRIA, France
Gustavo Olague, CICESE, Mexico
Riccardo Poli, University of Essex, UK
Conor Ryan, University of Limerick, Ireland
Stephen Smith, University of York, UK
Giovanni Squillero, Politecnico di Torino, Italy
Wolfgang Stolzmann, DaimlerChrysler, Germany
Kiyoshi Tanaka, Shinshu University, Japan
Ankur M. Teredesai, Rochester Institute of Technology, USA
Andy Tyrrell, University of York, UK
Robert Vanyi, Siemens PSE, Hungary
Hans-Michael Voigt, Center for Applied Computer Science (GFaI), Germany
Stewart Wilson, Prediction Dynamics, USA
Mengjie Zhang, Victoria University of Wellington, New Zealand

EvoMUSART Program Committee

Mauro Annunziato, Plancton Art Studio, Italy
Paul Brown, University of London, UK
Amlcar Cardoso, University of Coimbra, Portugal
Pierre Collet, Université du Littoral Côte d'Opale, France
John Gero, University of Sydney, Australia
Andrew Gartland-Jones, University of Sussex, UK
Carlos Grilo, School of Technology and Management of Leiria, Portugal
Matthew Lewis, Ohio State University, USA
Bill Manaris, College of Charleston, USA
Eduardo R. Miranda, University of Plymouth, UK
Ken Musgrave, Pandromeda Inc., USA
Francisco C. Pereira, University of Coimbra, Portugal

Luigi Pagliarini, Academy of Fine Arts of Rome, Italy and
University of Southern Denmark, Denmark
Juan Romero, Universidade da Coruña, Spain
Celestino Soddu, Politecnico de Milano, Italy
Tim Taylor, University of Edinburgh, UK
Jorge Tavares, CISUC, Centre for Informatics and Systems, Portugal
Stephen Todd, IBM, UK
Tatsuo Unemi, University of Zurich, Switzerland
Geraint Wiggins, City University, London, UK

EvoSTOC Program Committee

Dirk Arnold, Dalhousie University, Canada
Hans-Georg Beyer, Vorarlberg University of Applied Sciences, Austria
Tim Blackwell, Goldsmiths College, UK
Ernesto Costa, University of Coimbra, Portugal
Kalyan Deb, IIT Kanpur, India
Martin Middendorf, University of Leipzig, Germany
Ferrante Neri, Bari Polytechnic, Italy
Markus Olhofer, Honda Research Institute, Germany
Yew Soon Ong, Nanyang Technical University, Singapore
Khaled Rasheed, University of Georgia, USA
Christian Schmidt, University of Karlsruhe, Germany
Holger Ulmer, Robert Bosch GmbH, Germany
Sima Uyar, Istanbul Technical University, Turkey
Karsten Weicker, Leipzig University of Applied Sciences, Germany
Lars Willmes, NuTech GmbH, Germany
Shengxiang Yang, University of Leicester, UK

Sponsoring Institutions

EvoNet, the European Network of Excellence in Evolutionary Computing
University of Lausanne, Lausanne, Switzerland

Table of Contents

EvoBIO Contributions

Evolutionary Biclustering of Microarray Data
Jesus S. Aguilar-Ruiz, Federico Divina 1

A Fuzzy Viterbi Algorithm for Improved Sequence Alignment and Searching of Proteins
Niranjan P. Bidargaddi, Madhu Chetty, Joarder Kamruzzaman 11

Tabu Search Method for Determining Sequences of Amino Acids in Long Polypeptides
Jacek Błażewicz, Marcin Borowski, Piotr Formanowicz, Maciej Stobiecki 22

Order Preserving Clustering over Multiple Time Course Experiments
Stefan Bleuler, Eckart Zitzler 33

Can Neural Network Constraints in GP Provide Power to Detect Genes Associated with Human Disease?
William S. Bush, Alison A. Motsinger, Scott M. Dudek, Marylyn D. Ritchie 44

A Class of Pareto Archived Evolution Strategy Algorithms Using Immune Inspired Operators for Ab-Initio Protein Structure Prediction
Vincenzo Cutello, Giuseppe Narzisi, Giuseppe Nicosia 54

Neural Networks and Temporal Gene Expression Data
Abhay Krishna, Ajit Narayanan, E.C. Keedwell 64

Bayesian Learning with Local Support Vector Machines for Cancer Classification with Gene Expression Data
Elena Marchiori, Michèle Sebag 74

Genes Related with Alzheimer's Disease: A Comparison of Evolutionary Search, Statistical and Integer Programming Approaches
Pablo Moscato, Regina Berretta, Mou'ath Hourani, Alexandre Mendes, Carlos Cotta 84

Syntactic Approach to Predict Membrane Spanning Regions of Transmembrane Proteins
Koliya Pulasinghe, Jagath C. Rajapakse 95

An Evolutionary Approach for Motif Discovery and Transmembrane Protein Classification
Denise Fukumi Tsunoda, Heitor Silverio Lopes, Alex Alves Freitas 105

Differential Evolution and Its Application to Metabolic Flux Analysis
Jing Yang, Sarawan Wongsa, Visakan Kadirkamanathan, Stephen A. Billings, Phillip C. Wright 115

GEMPLS: A New QSAR Method Combining Generic Evolutionary Method and Partial Least Squares
Yen-Chih Chen, Jinn-Moon Yang, Chi-Hung Tsai, Cheng-Yan Kao 125

EvoCOMNET Contributions

A Performance Evaluation Framework for Nature Inspired Routing Algorithms
Horst F. Wedde, Muddassar Farooq 136

Empirical Models Based on Hybrid Intelligent Systems for Assessing the Reliability of Complex Networks
Douglas E. Torres D., Claudio M. Rocco S. 147

A Study of an Iterated Local Search on the Reliable Communication Networks Design Problem
Dirk Reichelt, Peter Gmilkowsky, Sebastian Linser 156

Unsupervised Anomaly Detection Based on an Evolutionary Artificial Immune Network
Liu Fang, Lin Le-Ping 166

Evolutionary Algorithms for Location Area Management
Bahar Karaoğlu, Haluk Topçuoğlu, Fikret Gürgen 175

EvoHOT Contributions

Evolutionary Design of Gate-Level Polymorphic Digital Circuits
Lukáš Sekanina 185

A Biological Development Model for the Design of Robust Multiplier
Heng Liu, Julian F. Miller, Andy M. Tyrrell 195

Automatic Completion and Refinement of Verification Sets for Microprocessor Cores
Ernesto Sánchez, Matteo Sonza Reorda, Giovanni Squillero 205

A Genetic Algorithm for VLSI Floorplanning Using O-Tree Representation
Maolin Tang, Alvin Sebastian 215

Evolving Reversible Circuits for the Even-Parity Problem
Mihai Oltean 225

Counter-Based Ant Colony Optimization as a Hardware-Oriented Meta-heuristic
Bernd Scheuermann, Martin Middendorf 235

Use of an Evolutionary Tool for Antenna Array Synthesis
Luca Manetta, Laura Ollino, Massimiliano Schillaci 245

EvoIASP Contributions

A Coevolutionary Approach for Clustering with Feature Weighting Application to Image Analysis
Alexandre Blansché, Pierre Gançarski, Jerzy J. Korczak 254

A New Evolutionary Algorithm for Image Segmentation
Leonardo Bocchi, Lucia Ballerini, Signe Hässler 264

An Interactive EA for Multifractal Bayesian Denoising
Evelyne Lutton, Pierre Grenier, Jacques Levy Vehel 274

Object Detection for Computer Vision Using a Robust Genetic Algorithm
Tania Mezzadri Centeno, Heitor Silvério Lopes, Marcelo Kleber Felisberto, Lúcia Valéria Ramos de Arruda 284

An Evolutionary Infection Algorithm for Dense Stereo Correspondence
Cynthia Beatriz Pérez, Gustavo Olague, Francisco Fernandez, Evelyne Lutton 294

Automatic Image Enhancement Driven by Evolution Based on Ridgelet Frame in the Presence of Noise
Tan Shan, Shuang Wang, Xiangrong Zhang, Licheng Jiao 304

Practical Evaluation of Efficient Fitness Functions for Binary Images
Róbert Ványi 314

Selective SVMs Ensemble Driven by Immune Clonal Algorithm
Xiangrong Zhang, Shuang Wang, Tan Shan, Licheng Jiao 325

Sensory-Motor Coordination in Gaze Control
Guido de Croon, Eric O. Postma, H. Jaap van den Herik 334

Region Merging for Severe Oversegmented Images Using a Hierarchical Social Metaheuristic
Abraham Duarte, Ángel Sánchez, Felipe Fernández, Antonio Sanz 345

Automated Photogrammetric Network Design Using the Parisian Approach
Enrique Dunn, Gustavo Olague, Evelyne Lutton 356

Design of Fast Multidimensional Filters Using Genetic Algorithms
Max Langer, Björn Svensson, Anders Brun, Mats Andersson, Hans Knutsson 366

Genetic-Fuzzy Optimization Algorithm for Adaptive Learning of Human Vocalization in Robotics
Enzo Mumolo, Massimiliano Nolich, Graziano Scalamera 376

Evolving Parameters of Surveillance Video Systems for Non-overfitted Learning
Óscar Pérez, Jesús García, Antonio Berlanga, José Manuel Molina . . 386

A Multistage Approach to Cooperatively Coevolving Feature Construction and Object Detection
Mark E. Roberts, Ela Claridge 396

An Implicit Context Representation for Evolving Image Processing Filters
Stephen L. Smith, Stefan Leggett, Andrew M. Tyrrell 407

Learning Weights in Genetic Programs Using Gradient Descent for Object Recognition
Mengjie Zhang, Will Smart 417

EvoMUSART Contributions

Open Problems in Evolutionary Music and Art
Jon McCormack 428

Genetic Paint: A Search for Salient Paintings
John P. Collomosse, Peter M. Hall 437

Artificial Life, Death and Epidemics in Evolutionary, Generative Electronic Art
Alan Dorin 448

The Electric Sheep Screen-Saver: A Case Study in Aesthetic Evolution
Scott Draves 458

Swarm Tech-Tiles
Tim Blackwell, Janis Jefferies 468

Evolutionary Methods for Ant Colony Paintings
Gary Greenfield 478

Evolutionary Search for Musical Parallelism
Søren Tjagvad Madsen, Gerhard Widmer 488

Developing Fitness Functions for Pleasant Music: Zipf's Law and Interactive Evolution Systems
Bill Manaris, Penousal Machado, Clayton McCauley, Juan Romero, Dwight Krehbiel 498

Understanding Expressive Music Performance Using Genetic Algorithms
Rafael Ramirez, Amaury Hazan 508

Toward User-Directed Evolution of Sound Synthesis Parameters
James McDermott, Niall J.L. Griffith, Michael O'Neill 517

Playing in the Pheromone Playground: Experiences in Swarm Painting
Paulo Urbano 527

Convergence Synthesis of Dynamic Frequency Modulation Tones Using an Evolution Strategy
Thomas J. Mitchell, Anthony G. Pipe 533

Granular Sampling Using a Pulse-Coupled Network of Spiking Neurons
Eduardo Reck Miranda, John Matthias 539

Growing Music: Musical Interpretations of L-Systems
Peter Worth, Susan Stepney 545

Exploring Rhythmic Automata
Andrew R. Brown 551

Extra-Music(ologic)al Models for Algorithmic Composition
Alice C. Eldridge 557

EvoSTOC Contributions

The Memory Indexing Evolutionary Algorithm for Dynamic Environments
Aydın Karaman, Şima Uyar, Gülşen Eryiğit 563

Dynamic Decentralized Packet Clustering in Networks
Daniel Merkle, Martin Middendorf, Alexander Scheidler 574

MOEA-Based Approach to Delayed Decisions for Robust Conceptual Design
Gideon Avigad, Amiram Moshaiov, Neima Brauner 584

Unified Particle Swarm Optimization in Dynamic Environments
Konstantinos E. Parsopoulos, Michael N. Vrahatis 590

Shaky Ladders, Hyperplane-Defined Functions and Genetic Algorithms: Systematic Controlled Observation in Dynamic Environments
William Rand, Rick Riolo 600

A Hierarchical Evolutionary Algorithm with Noisy Fitness in Structural Optimization Problems
Ferrante Neri, Anna V. Kononova, Giuseppe Delvecchio, Marcello Sylos Labini, Alexey V. Uglanov 610

Assortative Mating in Genetic Algorithms for Dynamic Problems
Gabriela Ochoa, Christian Mädler-Kron, Ricardo Rodriguez, Klaus Jaffe 617

A Hybrid Approach Based on Evolutionary Strategies and Interval Arithmetic to Perform Robust Designs
Claudio M. Rocco S. 623

Author Index 629