Lecture Notes in Computer Science 13399

Founding Editors

Gerhard Goos
Karlsruhe Institute of Technology, Karlsruhe, Germany

Juris Hartmanis
Cornell University, Ithaca, NY, USA

Editorial Board Members

Elisa Bertino
Purdue University, West Lafayette, IN, USA

Wen Gao
Peking University, Beijing, China

Bernhard Steffen
TU Dortmund University, Dortmund, Germany

Moti Yung
Columbia University, New York, NY, USA

More information about this series at https://link.springer.com/bookseries/558

Günter Rudolph · Anna V. Kononova ·
Hernán Aguirre · Pascal Kerschke ·
Gabriela Ochoa · Tea Tušar (Eds.)

Parallel Problem Solving from Nature – PPSN XVII

17th International Conference, PPSN 2022 Dortmund, Germany, September 10–14, 2022 Proceedings, Part II

Springer

Editors
Günter Rudolph
TU Dortmund
Dortmund, Germany

Hernán Aguirre
Shinshu University
Nagano, Japan

Gabriela Ochoa
University of Stirling
Stirling, UK

Anna V. Kononova
Leiden University
Leiden, The Netherlands

Pascal Kerschke
Technische Universität Dresden
Dresden, Germany

Tea Tušar
Jožef Stefan Institute
Ljubljana, Slovenia

ISSN 0302-9743 ISSN 1611-3349 (electronic)
Lecture Notes in Computer Science
ISBN 978-3-031-14720-3 ISBN 978-3-031-14721-0 (eBook)
https://doi.org/10.1007/978-3-031-14721-0

© The Editor(s) (if applicable) and The Author(s), under exclusive license
to Springer Nature Switzerland AG 2022
Chapters 19, 24 and 35 are licensed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/). For further details see license information in the chapters.
This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.
The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.
The publisher, the authors, and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

The first major gathering of people interested in discussing natural paradigms and their application to solve real-world problems in Europe took place in Dortmund, Germany, in 1990. What was planned originally as a small workshop with about 30 participants finally grew into an international conference named Parallel Problem Solving from Nature (PPSN) with more than 100 participants. The interest in the topics of the conference has increased steadily ever since leading to the pleasant necessity of organizing PPSN conferences biennially within the European region.

In times of a pandemic, it is difficult to find a host for a conference that should be held locally if possible. To ensure the continuation of the conference series, the 17th edition, PPSN 2022, returned to its birthplace in Dortmund. But even at the time of writing this text, it is unclear whether the conference can be held on-site or whether we shall have to switch to virtual mode at short notice.

Therefore, we are pleased that many researchers shared our optimism by submitting their papers for review. We received 185 submissions from which the program chairs have selected the top 85 after an extensive peer-review process. Not all decisions were easy to make but in all cases we benefited greatly from the careful reviews provided by the international Program Committee consisting of 223 scientists. Most of the submissions received four reviews, but all of them got at least three reviews. This led to a total of 693 reviews. Thanks to these reviews we were able to decide about acceptance on a solid basis.

The papers included in these proceedings have been assigned to 12 fuzzy clusters, entitled *Automated Algorithm Selection and Configuration, Bayesian- and Surrogate-Assisted Optimization, Benchmarking and Performance Measures, Combinatorial Optimization, (Evolutionary) Machine Learning and Neuroevolution, Evolvable Hardware and Evolutionary Robotics, Fitness Landscape Modeling and Analysis, Genetic Programming, Multi-Objective Optimization, Numerical Optimizaiton, Real-World Applications, and Theoretical Aspects of Nature-Inspired Optimization,* that can hardly reflect the true variety of research topics presented in the proceedings at hand. Following the tradition and spirit of PPSN, all papers were presented as posters. The 7 poster sessions consisting of about 12 papers each were compiled orthogonally to the fuzzy clusters mentioned above to cover the range of topics as widely as possible. As a consequence, participants with different interests would find some relevant papers in every session and poster presenters were able to discuss related work in sessions other than their own. As usual, the conference also included one day with workshops (Saturday), one day with tutorials (Sunday), and three invited plenary talks (Monday to Wednesday) for free.

Needless to say, the success of such a conference depends on the authors, reviewers, and organizers. We are grateful to all authors for submitting their best and latest work, to all the reviewers for the generous way they spent their time and provided their valuable expertise in preparing the reviews, to the workshop organizers and tutorial presenters

for their contributions enhancing the value of the conference, and to the local organizers who helped to make PPSN 2022 happen.

Last but not least, we would like to thank for the donations of the *Gesellschaft der Freunde der Technischen Universität Dortmund e.V. (GdF)* and the *Alumni der Informatik Dortmund e.V. (aido)*. We are grateful for Springer's long-standing support of this conference series. Finally, we thank the *Deutsche Forschungsgemeinschaft (DFG)* for providing financial backing.

July 2022

Günter Rudolph
Anna V. Kononova
Hernán Aguirre
Pascal Kerschke
Gabriela Ochoa
Tea Tušar

Organization

General Chair

Günter Rudolph	TU Dortmund University, Germany

Honorary Chair

Hans-Paul Schwefel	TU Dortmund University, Germany

Program Committee Chairs

Hernán Aguirre	Shinshu University, Japan
Pascal Kerschke	TU Dresden, Germany
Gabriela Ochoa	University of Stirling, UK
Tea Tušar	Jožef Stefan Institute, Slovenia

Proceedings Chair

Anna V. Kononova	Leiden University, The Netherlands

Tutorial Chair

Heike Trautmann	University of Münster, Germany

Workshop Chair

Christian Grimme	University of Münster, Germany

Publicity Chairs

Nicolas Fischöder	TU Dortmund University, Germany
Peter Svoboda	TU Dortmund University, Germany

Social Media Chair

Roman Kalkreuth	TU Dortmund University, Germany

Digital Fallback Chair

Hestia Tamboer	Leiden University, The Netherlands

Steering Committee

Thomas Bäck	Leiden University, The Netherlands
David W. Corne	Heriot-Watt University, UK
Carlos Cotta	Universidad de Málaga, Spain
Kenneth De Jong	George Mason University, USA
Gusz E. Eiben	Vrije Universiteit Amsterdam, The Netherlands
Bogdan Filipič	Jožef Stefan Institute, Slovenia
Emma Hart	Edinburgh Napier University, UK
Juan Julián Merelo Guervós	Universida de Granada, Spain
Günter Rudolph	TU Dortmund University, Germany
Thomas P. Runarsson	University of Iceland, Iceland
Robert Schaefer	University of Krakow, Poland
Marc Schoenauer	Inria, France
Xin Yao	University of Birmingham, UK

Program Committee

Jason Adair	University of Stirling, UK
Michael Affenzeller	University of Applied Sciences Upper Austria, Austria
Hernán Aguirre	Shinshu University, Japan
Brad Alexander	University of Adelaide, Australia
Richard Allmendinger	University of Manchester, UK
Marie Anastacio	Leiden University, The Netherlands
Denis Antipov	ITMO University, Russia
Claus Aranha	University of Tsukuba, Japan
Rolando Armas	Yachay Tech University, Ecuador
Dirk Arnold	Dalhousie University, Canada
Anne Auger	Inria, France
Dogan Aydin	Dumlupinar University, Turkey
Jaume Bacardit	Newcastle University, UK
Thomas Bäck	Leiden University, The Netherlands
Helio Barbosa	Laboratório Nacional de Computação Científica, Brazil
Andreas Beham	University of Applied Sciences Upper Austria, Austria
Heder Bernardino	Universidade Federal de Juiz de Fora, Brazil
Hans-Georg Beyer	Vorarlberg University of Applied Sciences, Austria

Julian Blank	Michigan State University, USA
Aymeric Blot	University College London, UK
Christian Blum	Spanish National Research Council, Spain
Peter Bosman	Centrum Wiskunde & Informatica, The Netherlands
Jakob Bossek	University of Münster, Germany
Jürgen Branke	University of Warwick, UK
Dimo Brockhoff	Inria, France
Alexander Brownlee	University of Stirling, UK
Larry Bull	University of the West of England, UK
Maxim Buzdalov	ITMO University, Russia
Arina Buzdalova	ITMO University, Russia
Stefano Cagnoni	University of Parma, Italy
Fabio Caraffini	De Montfort University, UK
Ying-Ping Chen	National Chiao Tung University, Taiwan
Francisco Chicano	University of Málaga, Spain
Miroslav Chlebik	University of Sussex, UK
Sung-Bae Cho	Yonsei University, South Korea
Tinkle Chugh	University of Exeter, UK
Carlos Coello Coello	CINVESTAV-IPN, Mexico
Ernesto Costa	University of Coimbra, Portugal
Carlos Cotta	Universidad de Málaga, Spain
Nguyen Dang	St Andrews University, UK
Kenneth De Jong	George Mason University, USA
Bilel Derbel	University of Lille, France
André Deutz	Leiden University, The Netherlands
Benjamin Doerr	Ecole Polytechnique, France
Carola Doerr	Sorbonne University, France
John Drake	University of Leicester, UK
Rafal Drezewski	AGH University of Science and Technology, Poland
Paul Dufossé	Inria, France
Gusz Eiben	Vrije Universiteit Amsterdam, The Netherlands
Mohamed El Yafrani	Aalborg University, Denmark
Michael Emmerich	Leiden University, The Netherlands
Andries Engelbrecht	University of Stellenbosch, South Africa
Anton Eremeev	Omsk Branch of Sobolev Institute of Mathematics, Russia
Richard Everson	University of Exeter, UK
Pedro Ferreira	Universidade de Lisboa, Portugal
Jonathan Fieldsend	University of Exeter, UK
Bogdan Filipič	Jožef Stefan Institute, Slovenia

Steffen Finck	Vorarlberg University of Applied Sciences, Austria
Andreas Fischbach	TH Köln, Germany
Marcus Gallagher	University of Queensland, Australia
José García-Nieto	University of Málaga, Spain
Mario Giacobini	University of Turin, Italy
Kyriakos Giannakoglou	National Technical University of Athens, Greece
Tobias Glasmachers	Ruhr-Universität Bochum, Germany
Christian Grimme	University of Münster, Germany
Andreia Guerreiro	University of Coimbra, Portugal
Alexander Hagg	Bonn-Rhein-Sieg University of Applied Sciences, Germany
Julia Handl	University of Manchester, UK
Jin-Kao Hao	University of Angers, France
Emma Hart	Napier University, UK
Verena Heidrich-Meisner	University Kiel, Germany
Jonathan Heins	TU Dresden, Germany
Carlos Henggeler Antunes	University of Coimbra, Portugal
Martin Holena	Institute of Computer Science, Czech Republic
Daniel Horn	TU Dortmund University, Germany
Christian Igel	University of Copenhagen, Denmark
Hisao Ishibuchi	Osaka Prefecture University, Japan
Domagoj Jakobović	University of Zagreb, Croatia
Thomas Jansen	Aberystwyth University, UK
Laetitia Jourdan	Inria, CNRS, CRIStAL, Université de Lille, France
George Karakostas	McMaster University, Canada
Pascal Kerschke	TU Dresden, Germany
Marie-Eleonore Kessaci	Université de Lille, France
Ahmed Kheiri	Lancaster University, UK
Wolfgang Konen	TH Köln, Germany
Lars Kotthoff	University of Wyoming, USA
Oliver Kramer	Universität Oldenburg, Germany
Oswin Krause	University of Copenhagen, Germany
Krzysztof Krawiec	Poznan University of Technology, Poland
Martin S. Krejca	Hasso Plattner Institute, Germany
Timo Kötzing	Hasso Plattner Institute, Germany
William La Cava	University of Pennsylvania, USA
William B. Langdon	University College London, UK
Frederic Lardeux	University of Angers, France
Per Kristian Lehre	University of Birmingham, UK
Johannes Lengler	ETH Zurich, Switzerland

Ke Li	University of Exeter, UK
Arnaud Liefooghe	University of Lille, France
Giosuè Lo Bosco	Università di Palermo, Italy
Fernando Lobo	University of Algarve, Portugal
Daniele Loiacono	Politecnico di Milano, Italy
Nuno Lourenço	University of Coimbra, Portugal
Jose A. Lozano	University of the Basque Country, Spain
Rodica Ioana Lung	Babes-Bolyai University, Romania
Chuan Luo	Peking University, China
Gabriel Luque	University of Málaga, Spain
Evelyne Lutton	INRAE, France
Manuel López-Ibáñez	University of Málaga, Spain
Penousal Machado	University of Coimbra, Portugal
Kaitlin Maile	ISAE-SUPAERO, France
Katherine Malan	University of South Africa, South Africa
Vittorio Maniezzo	University of Bologna, Italy
Elena Marchiori	Radboud University, The Netherlands
Asep Maulana	Tilburg University, The Netherlands
Giancarlo Mauri	University of Milano-Bicocca, Italy
Jacek Mańdziuk	Warsaw University of Technology, Poland
James McDermott	National University of Ireland, Galway, Ireland
Jörn Mehnen	University of Strathclyde, UK
Marjan Mernik	University of Maribor, Slovenia
Olaf Mersmann	TH Köln, Germany
Silja Meyer-Nieberg	Bundeswehr University Munich, Germany
Efrén Mezura-Montes	University of Veracruz, Mexico
Krzysztof Michalak	Wroclaw University of Economics, Poland
Kaisa Miettinen	University of Jyväskylä, Finland
Edmondo Minisci	University of Strathclyde, UK
Gara Miranda	University of La Laguna, Spain
Mustafa Misir	Istinye University, Turkey
Hugo Monzón	RIKEN, Japan
Sanaz Mostaghim	Fraunhofer IWS, Germany
Mario Andres Muñoz Acosta	University of Melbourne, Australia
Boris Naujoks	TH Köln, Germany
Antonio J. Nebro	University of Málaga, Spain
Aneta Neumann	University of Adelaide, Australia
Frank Neumann	University of Adelaide, Australia
Michael O'Neill	University College Dublin, Ireland
Pietro S. Oliveto	University of Sheffield, UK
Una-May O'Reilly	MIT, USA
José Carlos Ortiz-Bayliss	Tecnológico de Monterrey, Mexico

Patryk Orzechowski	University of Pennsylvania, USA
Ender Özcan	University of Nottingham, UK
Gregor Papa	Jožef Stefan Institute, Slovenia
Gisele Pappa	Universidade Federal de Minas Gerais, Brazil
Luis Paquete	University of Coimbra, Portugal
Andrew J. Parkes	University of Nottingham, UK
David Pelta	University of Granada, Spain
Leslie Perez-Caceres	Pontificia Universidad Católica de Valparaíso, Chile
Stjepan Picek	Delft University of Technology, The Netherlands
Martin Pilat	Charles University, Czech Republic
Nelishia Pillay	University of KwaZulu-Natal, South Africa
Petr Pošík	Czech Technical University in Prague, Czech Republic
Raphael Prager	University of Münster, Germany
Michał Przewoźniczek	Wroclaw University of Science and Technology, Poland
Chao Qian	University of Science and Technology of China, China
Xiaoyu Qin	University of Birmingham, UK
Alma Rahat	Swansea University, UK
Khaled Rasheed	University of Georgia, USA
Frederik Rehbach	TH Köln, Germany
Lucas Ribeiro	Universidade Federal de Goiás, Brazil
Eduardo Rodriguez-Tello	CINVESTAV, Tamaulipas, Mexico
Andrea Roli	University of Bologna, Italy
Jonathan Rowe	University of Birmingham, UK
Günter Rudolph	TU Dortmund University, Germany
Thomas A. Runkler	Siemens Corporate Technology, Germany
Conor Ryan	University of Limerick, Ireland
Frédéric Saubion	University of Angers, France
Robert Schaefer	AGH University of Science and Technology, Poland
Andrea Schaerf	University of Udine, Italy
David Schaffer	Binghamton University, USA
Lennart Schäpermeier	TU Dresden, Germany
Marc Schoenauer	Inria Saclay Île-de-France, France
Oliver Schütze	CINVESTAV-IPN, Mexico
Michele Sebag	CNRS, Université Paris-Saclay, France
Moritz Seiler	University of Münster, Germany
Bernhard Sendhoff	Honda Research Institute Europe GmbH, Germany

Marc Sevaux	Université de Bretagne Sud, France
Shinichi Shirakawa	Yokohama National University, Japan
Moshe Sipper	Ben-Gurion University of the Negev, Israel
Jim Smith	University of the West of England, UK
Jorge Alberto Soria-Alcaraz	Universidad de Guanajuato, Mexico
Patrick Spettel	FH Vorarlberg, Austria
Giovanni Squillero	Politecnico di Torino, Italy
Catalin Stoean	University of Craiova, Romania
Thomas Stützle	Université Libre de Bruxelles, Belgium
Mihai Suciu	Babes-Bolyai University, Romania
Dirk Sudholt	University of Sheffield, UK
Andrew Sutton	University of Minnesota, USA
Ricardo H. C. Takahashi	Universidade Federal de Minas Gerais, Brazil
Sara Tari	Université du Littoral Côte d'Opale, France
Daniel Tauritz	Auburn University, USA
Dirk Thierens	Utrecht University, The Netherlands
Sarah Thomson	University of Stirling, UK
Kevin Tierney	Bielefeld University, Germany
Renato Tinós	University of São Paulo, Brazil
Alberto Tonda	INRAE, France
Leonardo Trujillo	Instituto Tecnológico de Tijuana, Mexico
Tea Tušar	Jožef Stefan Institute, Slovenia
Ryan J. Urbanowicz	University of Pennsylvania, USA
Koen van der Blom	Leiden University, The Netherlands
Bas van Stein	Leiden University, The Netherlands
Nadarajen Veerapen	University of Lille, France
Sébastien Verel	Université du Littoral Côte d'Opale, France
Diederick Vermetten	Leiden University, The Netherlands
Marco Virgolin	Centrum Wiskunde & Informatica, The Netherlands
Aljoša Vodopija	Jožef Stefan Institute, Slovenia
Markus Wagner	University of Adelaide, Australia
Stefan Wagner	University of Applied Sciences Upper Austria, Austria
Hao Wang	Leiden University, The Netherlands
Hui Wang	Leiden University, The Netherlands
Elizabeth Wanner	CEFET, Brazil
Marcel Wever	LMU Munich, Germany
Dennis Wilson	ISAE-SUPAERO, France
Carsten Witt	Technical University of Denmark, Denmark
Man Leung Wong	Lingnan University, Hong Kong
Bing Xue	Victoria University of Wellington, New Zealand

Kaifeng Yang	University of Applied Sciences Upper Austria, Austria
Shengxiang Yang	De Montfort University, UK
Estefania Yap	University of Melbourne, Australia
Furong Ye	Leiden University, The Netherlands
Martin Zaefferer	TH Köln, Germany
Aleš Zamuda	University of Maribor, Slovenia
Saúl Zapotecas	Instituto Nacional de Astrofísica, Óptica y Electrónica, Mexico
Christine Zarges	Aberystwyth University, UK
Mengjie Zhang	Victoria University of Wellington, New Zealand

Keynote Speakers

Doina Bucur	University of Twente, The Netherlands
Claudio Semini	IIT, Genoa, Italy
Travis Waller	TU Dresden, Germany

Contents – Part II

Genetic Programming

Digging into Semantics: Where Do Search-Based Software Repair Methods Search? 3
Hammad Ahmad, Padriac Cashin, Stephanie Forrest, and Westley Weimer

Gene-pool Optimal Mixing in Cartesian Genetic Programming 19
Joe Harrison, Tanja Alderliesten, and Peter A. N. Bosman

Genetic Programming for Combining Directional Changes Indicators in International Stock Markets 33
Xinpeng Long, Michael Kampouridis, and Panagiotis Kanellopoulos

Importance-Aware Genetic Programming for Automated Scheduling Heuristics Learning in Dynamic Flexible Job Shop Scheduling 48
Fangfang Zhang, Yi Mei, Su Nguyen, and Mengjie Zhang

Towards Discrete Phenotypic Recombination in Cartesian Genetic Programming 63
Roman Kalkreuth

Multi-Objective Optimization

A General Architecture for Generating Interactive Decomposition-Based MOEAs 81
Giomara Lárraga and Kaisa Miettinen

An Exact Inverted Generational Distance for Continuous Pareto Front 96
Zihan Wang, Chunyun Xiao, and Aimin Zhou

Direction Vector Selection for R2-Based Hypervolume Contribution Approximation 110
Tianye Shu, Ke Shang, Yang Nan, and Hisao Ishibuchi

Do We Really Need to Use Constraint Violation in Constrained Evolutionary Multi-objective Optimization? 124
Shuang Li, Ke Li, and Wei Li

Dynamic Multi-modal Multi-objective Optimization: A Preliminary Study 138
Yiming Peng and Hisao Ishibuchi

Fair Feature Selection with a Lexicographic Multi-objective Genetic Algorithm 151
James Brookhouse and Alex Freitas

Greedy Decremental Quick Hypervolume Subset Selection Algorithms 164
Andrzej Jaszkiewicz and Piotr Zielniewicz

Hybridizing Hypervolume-Based Evolutionary Algorithms and Gradient Descent by Dynamic Resource Allocation 179
Damy M. F. Ha, Timo M. Deist, and Peter A. N. Bosman

Identifying Stochastically Non-dominated Solutions Using Evolutionary Computation 193
Hemant Kumar Singh and Juergen Branke

Large-Scale Multi-objective Influence Maximisation with Network Downscaling 207
Elia Cunegatti, Giovanni Iacca, and Doina Bucur

Multi-Objective Evolutionary Algorithm Based on the Linear Assignment Problem and the Hypervolume Approximation Using Polar Coordinates (MOEA-LAPCO) 221
Diana Cristina Valencia-Rodríguez and Carlos Artemio Coello Coello

New Solution Creation Operator in MOEA/D for Faster Convergence 234
Longcan Chen, Lie Meng Pang, and Hisao Ishibuchi

Obtaining Smoothly Navigable Approximation Sets in Bi-objective Multi-modal Optimization 247
Renzo J. Scholman, Anton Bouter, Leah R. M. Dickhoff, Tanja Alderliesten, and Peter A. N. Bosman

T-DominO: Exploring Multiple Criteria with Quality-Diversity and the Tournament Dominance Objective 263
Adam Gaier, James Stoddart, Lorenzo Villaggi, and Peter J. Bentley

Numerical Optimizaiton

Collective Learning of Low-Memory Matrix Adaptation for Large-Scale Black-Box Optimization 281
Qiqi Duan, Guochen Zhou, Chang Shao, Yijun Yang, and Yuhui Shi

Recombination Weight Based Selection in the DTS-CMA-ES 295
Oswin Krause

The (1+1)-ES Reliably Overcomes Saddle Points 309
Tobias Glasmachers

Real-World Applications

Evolutionary Time-Use Optimization for Improving Children's Health Outcomes 323
Yue Xie, Aneta Neumann, Ty Stanford, Charlotte Lund Rasmussen, Dorothea Dumuid, and Frank Neumann

Iterated Local Search for the eBuses Charging Location Problem 338
César Loaiza Quintana, Laura Climent, and Alejandro Arbelaez

Multi-view Clustering of Heterogeneous Health Data: Application to Systemic Sclerosis 352
Adán José-García, Julie Jacques, Alexandre Filiot, Julia Handl, David Launay, Vincent Sobanski, and Clarisse Dhaenens

Specification-Driven Evolution of Floor Plan Design 368
Katarzyna Grzesiak-Kopeć, Barbara Strug, and Grażyna Ślusarczyk

Surrogate-Assisted Multi-objective Optimization for Compiler Optimization Sequence Selection 382
Guojun Gao, Lei Qiao, Dong Liu, Shifei Chen, and He Jiang

Theoretical Aspects of Nature-Inspired Optimization

A First Runtime Analysis of the NSGA-II on a Multimodal Problem 399
Benjamin Doerr and Zhongdi Qu

Analysis of Quality Diversity Algorithms for the Knapsack Problem 413
Adel Nikfarjam, Anh Viet Do, and Frank Neumann

Better Running Time of the Non-dominated Sorting Genetic Algorithm II (NSGA-II) by Using Stochastic Tournament Selection 428
Chao Bian and Chao Qian

Escaping Local Optima with Local Search: A Theory-Driven Discussion 442
Tobias Friedrich, Timo Kötzing, Martin S. Krejca, and Amirhossein Rajabi

Evolutionary Algorithms for Cardinality-Constrained Ising Models 456
Vijay Dhanjibhai Bhuva, Duc-Cuong Dang, Liam Huber, and Dirk Sudholt

General Univariate Estimation-of-Distribution Algorithms 470
Benjamin Doerr and Marc Dufay

Population Diversity Leads to Short Running Times of Lexicase Selection 485
Thomas Helmuth, Johannes Lengler, and William La Cava

Progress Rate Analysis of Evolution Strategies on the Rastrigin Function: First Results 499
Amir Omeradzic and Hans-Georg Beyer

Running Time Analysis of the (1+1)-EA Using Surrogate Models on OneMax and LeadingOnes 512
Zi-An Zhang, Chao Bian, and Chao Qian

Runtime Analysis of Simple Evolutionary Algorithms for the Chance-Constrained Makespan Scheduling Problem 526
Feng Shi, Xiankun Yan, and Frank Neumann

Runtime Analysis of the (1+1) EA on Weighted Sums of Transformed Linear Functions 542
Frank Neumann and Carsten Witt

Runtime Analysis of Unbalanced Block-Parallel Evolutionary Algorithms 555
Brahim Aboutaib and Andrew M. Sutton

Self-adjusting Population Sizes for the $(1, \lambda)$-EA on Monotone Functions 569
Marc Kaufmann, Maxime Larcher, Johannes Lengler, and Xun Zou

Theoretical Study of Optimizing Rugged Landscapes with the cGA 586
Tobias Friedrich, Timo Kötzing, Frank Neumann, and Aishwarya Radhakrishnan

Towards Fixed-Target Black-Box Complexity Analysis 600
Dmitry Vinokurov and Maxim Buzdalov

Two-Dimensional Drift Analysis: Optimizing Two Functions Simultaneously Can Be Hard 612
Duri Janett and Johannes Lengler

Author Index 627

Contents – Part I

Automated Algorithm Selection and Configuration

Automated Algorithm Selection in Single-Objective Continuous Optimization: A Comparative Study of Deep Learning and Landscape Analysis Methods 3
Raphael Patrick Prager, Moritz Vinzent Seiler, Heike Trautmann, and Pascal Kerschke

Improving Nevergrad's Algorithm Selection Wizard NGOpt Through Automated Algorithm Configuration 18
Risto Trajanov, Ana Nikolikj, Gjorgjina Cenikj, Fabien Teytaud, Mathurin Videau, Olivier Teytaud, Tome Eftimov, Manuel López-Ibáñez, and Carola Doerr

Non-elitist Selection Can Improve the Performance of Irace 32
Furong Ye, Diederick Vermetten, Carola Doerr, and Thomas Bäck

Per-run Algorithm Selection with Warm-Starting Using Trajectory-Based Features 46
Ana Kostovska, Anja Jankovic, Diederick Vermetten, Jacob de Nobel, Hao Wang, Tome Eftimov, and Carola Doerr

Bayesian- and Surrogate-Assisted Optimization

A Systematic Approach to Analyze the Computational Cost of Robustness in Model-Assisted Robust Optimization 63
Sibghat Ullah, Hao Wang, Stefan Menzel, Bernhard Sendhoff, and Thomas Bäck

Adaptive Function Value Warping for Surrogate Model Assisted Evolutionary Optimization 76
Amir Abbasnejad and Dirk V. Arnold

Efficient Approximation of Expected Hypervolume Improvement Using Gauss-Hermite Quadrature 90
Alma Rahat, Tinkle Chugh, Jonathan Fieldsend, Richard Allmendinger, and Kaisa Miettinen

Finding Knees in Bayesian Multi-objective Optimization 104
Arash Heidari, Jixiang Qing, Sebastian Rojas Gonzalez, Jürgen Branke, Tom Dhaene, and Ivo Couckuyt

High Dimensional Bayesian Optimization with Kernel Principal Component Analysis 118
Kirill Antonov, Elena Raponi, Hao Wang, and Carola Doerr

Single Interaction Multi-Objective Bayesian Optimization 132
Juan Ungredda, Juergen Branke, Mariapia Marchi, and Teresa Montrone

Surrogate-Assisted LSHADE Algorithm Utilizing Recursive Least Squares Filter 146
Mateusz Zaborski and Jacek Mańdziuk

Towards Efficient Multiobjective Hyperparameter Optimization: A Multiobjective Multi-fidelity Bayesian Optimization and Hyperband Algorithm 160
Zefeng Chen, Yuren Zhou, Zhengxin Huang, and Xiaoyun Xia

Benchmarking and Performance Measures

A Continuous Optimisation Benchmark Suite from Neural Network Regression 177
Katherine M. Malan and Christopher W. Cleghorn

BBE: Basin-Based Evaluation of Multimodal Multi-objective Optimization Problems 192
Jonathan Heins, Jeroen Rook, Lennart Schäpermeier, Pascal Kerschke, Jakob Bossek, and Heike Trautmann

Evolutionary Approaches to Improving the Layouts of Instance-Spaces 207
Kevin Sim and Emma Hart

Combinatorial Optimization

A Novelty-Search Approach to Filling an Instance-Space with Diverse and Discriminatory Instances for the Knapsack Problem 223
Alejandro Marrero, Eduardo Segredo, Coromoto León, and Emma Hart

Co-evolutionary Diversity Optimisation for the Traveling Thief Problem 237
Adel Nikfarjam, Aneta Neumann, Jakob Bossek, and Frank Neumann

Computing High-Quality Solutions for the Patient Admission Scheduling Problem Using Evolutionary Diversity Optimisation 250
Adel Nikfarjam, Amirhossein Moosavi, Aneta Neumann, and Frank Neumann

Cooperative Multi-agent Search on Endogenously-Changing Fitness Landscapes 265
Chin Woei Lim, Richard Allmendinger, Joshua Knowles, Ayesha Alhosani, and Mercedes Bleda

Evolutionary Algorithm for Vehicle Routing with Diversity Oscillation Mechanism 279
Piotr Cybula, Andrzej Jaszkiewicz, Przemysław Pełka, Marek Rogalski, and Piotr Sielski

Evolutionary Algorithms for Limiting the Effect of Uncertainty for the Knapsack Problem with Stochastic Profits 294
Aneta Neumann, Yue Xie, and Frank Neumann

Self-adaptation via Multi-objectivisation: An Empirical Study 308
Xiaoyu Qin and Per Kristian Lehre

The Combined Critical Node and Edge Detection Problem. An Evolutionary Approach 324
Tamás Képes, Noémi Gaskó, and Géza Vekov

(Evolutionary) Machine Learning and Neuroevolution

Attention-Based Genetic Algorithm for Adversarial Attack in Natural Language Processing 341
Shasha Zhou, Ke Li, and Geyong Min

Deep Reinforcement Learning with Two-Stage Training Strategy for Practical Electric Vehicle Routing Problem with Time Windows 356
Jinbiao Chen, Huanhuan Huang, Zizhen Zhang, and Jiahai Wang

Evolving Through the Looking Glass: Learning Improved Search Spaces with Variational Autoencoders 371
Peter J. Bentley, Soo Ling Lim, Adam Gaier, and Linh Tran

Generalization and Computation for Policy Classes of Generative Adversarial Imitation Learning 385
Yirui Zhou, Yangchun Zhang, Xiaowei Liu, Wanying Wang, Zhengping Che, Zhiyuan Xu, Jian Tang, and Yaxin Peng

Generative Models over Neural Controllers for Transfer Learning 400
James Butterworth, Rahul Savani, and Karl Tuyls

HVC-Net: Deep Learning Based Hypervolume Contribution Approximation 414
Ke Shang, Weiduo Liao, and Hisao Ishibuchi

Multi-objective Evolutionary Ensemble Pruning Guided by Margin Distribution 427
Yu-Chang Wu, Yi-Xiao He, Chao Qian, and Zhi-Hua Zhou

Revisiting Attention-Based Graph Neural Networks for Graph Classification 442
Ye Tao, Ying Li, and Zhonghai Wu

Robust Neural Network Pruning by Cooperative Coevolution 459
Jia-Liang Wu, Haopu Shang, Wenjing Hong, and Chao Qian

SemiGraphFL: Semi-supervised Graph Federated Learning for Graph Classification 474
Ye Tao, Ying Li, and Zhonghai Wu

Evolvable Hardware and Evolutionary Robotics

Evolutionary Design of Reduced Precision Preprocessor for Levodopa-Induced Dyskinesia Classifier 491
Martin Hurta, Michaela Drahosova, and Vojtech Mrazek

In-Materio Extreme Learning Machines 505
Benedict. A. H. Jones, Noura Al Moubayed, Dagou A. Zeze, and Chris Groves

On the Impact of the Duration of Evaluation Episodes on the Evolution of Adaptive Robots 520
Larissa Gremelmaier Rosa, Vitor Hugo Homem, Stefano Nolfi, and Jônata Tyska Carvalho

Fitness Landscape Modeling and Analysis

Analysing the Fitness Landscape Rotation for Combinatorial Optimisation 533
Joan Alza, Mark Bartlett, Josu Ceberio, and John McCall

Analysis of Search Landscape Samplers for Solver Performance Prediction on a University Timetabling Problem 548
Thomas Feutrier, Marie-Éléonore Kessaci, and Nadarajen Veerapen

Fractal Dimension and Perturbation Strength: A Local Optima Networks View 562
Sarah L. Thomson, Gabriela Ochoa, and Sébastien Verel

HPO × ELA: Investigating Hyperparameter Optimization Landscapes by Means of Exploratory Landscape Analysis 575
Lennart Schneider, Lennart Schäpermeier, Raphael Patrick Prager, Bernd Bischl, Heike Trautmann, and Pascal Kerschke

Increasing the Diversity of Benchmark Function Sets Through Affine Recombination 590
Konstantin Dietrich and Olaf Mersmann

Neural Architecture Search: A Visual Analysis 603
Gabriela Ochoa and Nadarajen Veerapen

Author Index 617