Lecture Notes in Computer Science 6457

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

Alfred Kobsa
University of California, Irvine, CA, 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
TU Dortmund University, Germany

Madhu Sudan
Microsoft Research, Cambridge, MA, USA

Demetri Terzopoulos
University of California, Los Angeles, CA, USA

Doug Tygar
University of California, Berkeley, CA, USA

Gerhard Weikum
Max Planck Institute for Informatics, Saarbruecken, Germany

Kalyanmoy Deb Arnab Bhattacharya
Nirupam Chakraborti Partha Chakroborty
Swagatam Das Joydeep Dutta
Santosh K. Gupta Ashu Jain
Varun Aggarwal Jürgen Branke
Sushil J. Louis Kay Chen Tan (Eds.)

Simulated Evolution and Learning

8th International Conference, SEAL 2010
Kanpur, India, December 1-4, 2010
Proceedings

Springer

Volume Editors

Kalyanmoy Deb
Arnab Bhattacharya
Partha Chakroborty
Joydeep Dutta
Santosh K. Gupta
Ashu Jain
Indian Institute of Technology Kanpur, Kanpur, Uttar Pradesh 208016, India
{deb, arnabb, partha, jdutta, skgupta, ashujain}@iitk.ac.in

Nirupam Chakraborti
Indian Institute of Technology Kharagpur, India, nchakrab@gmail.com

Swagatam Das
Jadavpur University, Kolkata, India, swagatamdas19@yahoo.co.in

Varun Aggarwal
Aspiring Minds, New Delhi, India, varun@aspiringminds.in

Jürgen Branke
University of Warwick, Coventry, UK, juergen.branke@wbs.ac.uk

Sushil J. Louis
University of Nevada, Reno, USA, sushil@cse.unr.edu

Kay Chen Tan
National University of Singapore, eletankc@nus.edu.sg

Library of Congress Control Number: 2010939055

CR Subject Classification (1998): F.1.1, I.2.6, I.6, G.1.6, H.3, D.2.2, J.3-4

LNCS Sublibrary: SL 1 – Theoretical Computer Science and General Issues

ISSN 0302-9743
ISBN-10 3-642-17297-0 Springer Berlin Heidelberg New York
ISBN-13 978-3-642-17297-7 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.com

© Springer-Verlag Berlin Heidelberg 2010
Printed in Germany

Typesetting: Camera-ready by author, data conversion by Scientific Publishing Services, Chennai, India
Printed on acid-free paper 06/3180

Preface

This LNCS volume contains the papers presented at the 8th Simulated Evolution and Learning (SEAL 2010) Conference held during December 1–4, 2010 at the Indian Institute of Technology Kanpur in India. SEAL is a prestigious international conference series in evolutionary optimization and machine learning. This biennial event started in Seoul, South Korea in 1996 and was thereafter held in Canberra, Australia in 1998, Nagoya, Japan in 2000, Singapore in 2002, Busan, South Korea in 2004, Hefei, China in 2006 and Melbourne, Australia in 2008.

SEAL 2010 received 141 paper submissions in total from 30 countries. After a rigorous peer-review process involving 431 reviews in total (averaging a little more than 3 reviews per paper), 60 full-length and 19 short papers were accepted for presentation (both oral and poster) at the conference. The full-length papers alone correspond to a 42.6% acceptance rate and short papers add another 13.5%.

The papers included in this LNCS volume cover a wide range of topics in simulated evolution and learning. The accepted papers have been classified into the following main categories: (a) theoretical developments, (b) evolutionary algorithms and applications, (c) learning methodologies, (d) multi-objective evolutionary algorithms and applications, (e) hybrid algorithms and (f) industrial applications.

The conference featured three distinguished keynote speakers. Narendra Karmarkar's talk on "Beyond Convexity: New Perspectives in Computational Optimization" focused on providing new theoretical concepts for non-convex optimization and indicated a rich connection between optimization and mathematical physics and also showed a deep significance of advanced geometry to optimization. The advancement of optimization theory for non-convex problems is beneficial for meta-heuristic optimization algorithms such as evolutionary algorithms. Manindra Agrawal's talk on "PRIMES is in P" provided a much-improved version of his celebrated and ground-breaking 2002 work on polynomial time algorithm for testing prime numbers. The theoretical computation work presented in this keynote lecture should be motivating for the evolutionary optimization and machine learning community at large. Toshio Fukuda's talk on "Intelligent Robot for Multi-mode Locomotion" showcased how multiple locomotions adopted by animals can be mimicked in developing highly robust robots for performing different tasks. The learning behaviors portrayed in the talk should be motivating to the researchers in evolutionary learning and robotics alike.

SEAL 2010 also included two tutorials, which were free to all conference participants. Tutorial topics were chosen from two complementary areas of evolutionary computing. B. Yegnanarayana's tutorial on "Artificial Neural Networks and Applications in Optimization" systematically introduced the principles of artificial neural networks (ANN) and their applications in various problems. ANN has been extensively used in learning and modeling problems; however, an efficient use of ANN requires knowledge and understanding of the intricacies

of its fundamental principles. This tutorial inspired both novices and experts of ANN to a greater understanding of the very fundamentals of its working principles. The tutorial by Debabrata Goswami on "Quantum Computing" introduced the fast-growing methodologies of quantum computing techniques. The ideas portrayed in the tutorial motivated evolutionary computing researchers to pay more attention to the collaborative activities between the two fields. These two tutorials made an excellent start to the four-day conference.

We take this opportunity to thank authors of all submitted papers for their hard work, adherence to the deadlines and patience with the review process. The quality of a refereed volume depends mainly on the expertise and dedication of the reviewers. We are indebted to the Program Committee members, who not only produced excellent reviews but also did these in the short time frames that they were given. The review process would not have been possible without the tireless dedication of Amit Saha and Shivam Gupta and their coherent core team at KanGAL (Sunith Bandaru, Rituparna Dutta, Soumil Srivastava, Rupesh Srivastava, and Rupesh Tulshyan) in interacting with authors, Program Committee members and simultaneously with the Chairs.

We would also like to thank our sponsors for providing all the support and financial assistance. First, we are indebted to the IIT Kanpur administration team (the director, the deputy director, deans, and faculty colleagues and administrative personnel) for supporting our cause and encouraging us to organize the conference at IIT Kanpur. We would like to thank Xin Yao, Xiaodong Li, Mengjie Zhang for showing confidence in us in organizing the SEAL 2010 conference in India. The financial assistance from the Golden Jubilee Committee, IIT Kanpur, Department of Science and Technology (DST), New Delhi, and the Council of Scientific and Industrial Research (CSIR), New Delhi in meeting a major portion of the expenses is highly appreciated. Contributions including financial support from Esteco, Italy and USA, General Electric, Bangalore, General Motors, Bangalore, and TCS Innovation Lab, Delhi, were extremely helpful in arranging the conference. We would also like to thank the participants of this conference who, despite the difficulties in getting to Kanpur, considered attending the conference above all hardships. Finally, we would like to thank all the volunteers whose tireless efforts included meeting the deadlines and arranging every detail to make sure that the conference ran smoothly. We hope the readers of these proceedings find the papers inspiring and enjoyable.

December 2010

Kalyanmoy Deb
Varun Aggarwal
Arnab Bhattacharya
Nirupam Chakraborti
Partha Chakroborty
Swagatam Das
Joydeep Dutta
Santosh K. Gupta
Ashu Jain

Organization

SEAL 2010 was organized by the Kanpur Genetic Algorithms Laboratory (KanGAL), Indian Institute of Technology Kanpur, India.

Executive Commitee

General Chair:	Kalyanmoy Deb, India
Program Chairs:	Arnab Bhattacharya, India Nirupam Chakraborti, India Partha Chakroborty, India Swagatam Das, India Joydeep Dutta, India Santosh K. Gupta, India Ashu Jain, India
Industrial Session Chair:	Varun Aggarwal, India
Technical Co-chairs:	Jürgen Branke, UK Sushil J. Louis, USA Kay Chen Tan, Singapore
International Advisory Committee:	Thomas Bäck, The Netherlands Vijay Chandru, India Peter Fleming, UK Eric Goodman, USA Jong-Hwan Kim, Korea Zbigniew Michalewicz, Australia Una-May O'Reilly, USA Asim K. Pal, India Hans-Paul Schwefel, Germany Lothar Thiele, Switzerland Xin Yao, UK

Tutorials

Title: Quantum Computing
Speaker: Debabrata Goswami

Title: Artificial Neural Networks and Applications in Optimization
Speaker: B. Yegnanarayana

Keynote Lectures

Title: PRIMES is in P
Speaker: Manindra Agrawal

Title: Intelligent Robot for Multi-mode Locomotion
Speaker: Toshio Fukuda

Title: Beyond Convexity: Towards Mathematical Foundation for Non-convex Optimization
Speaker: Narendra Karmarkar

Sponsoring Agencies

Kanpur Genetic Algorithms Laboratory (KanGAL)
Indian Institute of Technology Kanpur, India
Golden Jubilee Committee, IIT Kanpur, India
Department of Science and Technology (DST), New Delhi
Council of Scientific and Industrial Research (CSIR), New Delhi
ESTECO, Italy and USA
TCS Innovation Laboratory, Delhi, India
General Electric, Bangalore, India
General Motors, Bangalore, India

Program Committee

Aboubekeur Hamdi-Cherif
Adam Berry
Adam Ghandar
Ah King Robert
Ali Riza Yildiz
Amit Saha
Amos Ng
Andrew Lewis
Andries Engelbrecht
Andy Tyrrell
Aniruddha Basak
Ankit Palliwal
Ankur Sinha
Anna Piwonska
Arnab Bhattacharya
Arjun Chandra
Arnob Ghosh
Arup Nandi
Ashutosh Tiwari
Bishakh Bhattacharya
Bob Mckay
B.V. Babu
Byoung-Tak Zhang
Carlos Coello Coello
Carlos Fonseca
Christie Myburgh
Clarisse Dhaenens
Dario Landa-Silva
David Corne
Deepak Sharma
Dhanesh Padmanabhan
Dhish Saxena
Dilip Datta
Dilip Pratihar
Dimo Brockhoff
Dipankar Dasgupta
Efrén Mezura-Montes
Enrico Rigoni
Enrique Alba
Fransisco Ruiz
G. Saravana Kumar
G.N. Sashi Kumar
Gary Lamont
Gaspar Cunha
Gustavo Recio
Hans-Georg Beyer
Helio J.C. Barbosa
Henrik Saxén
Hisao Ishibuchi
Hussein Abbass
Jesper Genri Hattel
Jin-Kao Hao
João Vasconcelos
Jong-Hwan Kim
Julian Molina
Kalyan Veeramachaneni
Kalyanmoy Deb
Kareti V.R.B. Prasad
Karthik Sindhya

Kou Gang
Kun Wang
Laetitia Jourdan
Laxmidhar Behera
Lothar Thiele
Luis Marti
Madan Dabbeeru
March Schoenauer
Martin Holena
Matthias Ehrgott
Michael Emmerich
Mukesh Raghuwanshi
N.N. Kishore
Nicola Beume
Nikhil Padhye
Nirupam Chakraborti
Nugroho Fredivianus
Oliver Schütze
Paul Grouchy
Pawan Nain
Peeyush Mehta
Peter Fleming
Pierre Collet
Piyush Bhardwaj
Ponnuthurai Suganthan
Prabha Sharma
Pramod Singh
P.V.M. Rao
Qingfu Zhang
Raghu Sengupta
Rahul Caprihan
Rahul Kala
Ranjan Ganguli
Rituparna Datta
Robin Purshouse
Rolf Drechsler
Rupesh K. Srivastava
Rupesh Tulshyan
Saber Elsayed
Salvatore Greco
Sanaz Mostaghim
Sanghamitra Bandyopadhyay
Santosh K. Gupta
Santosh Tiwari
Swagatam Das
Shamik Chaudhuri
Shivam Gupta
Silvia Poles
S.N. Singh
Soumil Srivastava
Sunith Bandaru
Tapabrata Ray
Tatsuya Okabe
V. Ravi
Varun Aggarwal
Vikas Kumar Garg
Vinay Ramanath
Vineet Khare
Vipin Tripathi
Weihang Zhu
Wozniak Piotr
Yaochu Jin
Yusuke Nojima

Table of Contents

Invited Paper

Beyond Convexity: New Perspectives in Computational Optimization . . . 1
Narendra Karmarkar

Theoretical Developments

Optimal μ-Distributions for the Hypervolume Indicator for Problems with Linear Bi-objective Fronts: Exact and Exhaustive Results 24
Dimo Brockhoff

A Parallel Algorithm for Solving Large Convex Minimax Problems 35
Ramnik Arora, Utkarsh Upadhyay, Rupesh Tulshyan, and J. Dutta

Towards Efficient and Effective Negative Selection Algorithm: A Convex Hull Representation Scheme 45
Mahshid Majd, Farzaneh Shoeleh, Ali Hamzeh, and Sattar Hashemi

To Handle Real Valued Input in XCS: Using Fuzzy Hyper-trapezoidal Membership in Classifier Condition 55
Farzaneh Shoeleh, Ali Hamzeh, and Sattar Hashemi

Development of Optimal Control System for Safe Distance of Platooning Using Model Predictive Control 65
Xin Zhao, Dongmei Wu, Yichun Yeh, and Harutoshi Ogai

A Comparative Study on Theoretical and Empirical Evolution of Population Variance of Differential Evolution Variants 75
G. Jeyakumar and C. Shunmuga Velayutham

Generating Sequential Space-Filling Designs Using Genetic Algorithms and Monte Carlo Methods 80
Karel Crombecq and Tom Dhaene

Evolutionary Algorithms and Applications

MP-EDA: A Robust Estimation of Distribution Algorithm with Multiple Probabilistic Models for Global Continuous Optimization 85
Jing-hui Zhong, Jun Zhang, and Zhun Fan

A Bi-criterion Approach to Multimodal Optimization: Self-adaptive Approach 95
Amit Saha and Kalyanmoy Deb

On the Flexible Applied Boundary and Support Conditions of Compliant Mechanisms Using Customized Evolutionary Algorithm 105
Deepak Sharma

Intensification Strategies for Extremal Optimisation 115
Marcus Randall and Andrew Lewis

Comparing Two Constraint Handling Techniques in a Binary-Coded Genetic Algorithm for Optimization Problems 125
Helio J.C. Barbosa, Afonso C.C. Lemonge, Leonardo G. Fonseca, and Heder S. Bernardino

Evolving Stories: Tree Adjoining Grammar Guided Genetic Programming for Complex Plot Generation 135
Kun Wang, Vinh Q. Bui, and Hussein A. Abbass

Improving Differential Evolution by Altering Steps in EC 146
Nikhil Padhye, Piyush Bhardawaj, and Kalyanmoy Deb

A Dynamic Island-Based Genetic Algorithms Framework 156
Frédéric Lardeux and Adrien Goëffon

Solving the Optimal Coverage Problem in Wireless Sensor Networks Using Evolutionary Computation Algorithms 166
Zhi-hui Zhan, Jun Zhang, and Zhun Fan

A Comparative Study of Different Variants of Genetic Algorithms for Constrained Optimization 177
Saber M. Elsayed, Ruhul A. Sarker, and Daryl L. Essam

Evolutionary FCMAC-BYY Applied to Stream Data Analysis 187
D. Shi, M. Loomes, and M.N. Nguyen

UNIFAC Group Interaction Prediction for Ionic Liquid-Thiophene Based Systems Using Genetic Algorithm 195
Surya Pratap Singh, Ramalingam Anantharaj, and Tamal Banerjee

HIER-HEIR: An Evolutionary System with Hierarchical Representation and Operators Applied to Fashion Design 205
Abhinav Malhotra and Varun Aggarwal

A Population Diversity-Oriented Gene Expression Programming for Function Finding 215
Ruochen Liu, Qifeng Lei, Jing Liu, and Licheng Jiao

Learning Methodologies

Evolutionary Optimization of Catalysts Assisted by Neural-Network Learning 220
Martin Holeňa, David Linke, and Uwe Rodemerck

Dominance-Based Pareto-Surrogate for Multi-Objective Optimization 230
Ilya Loshchilov, Marc Schoenauer, and Michèle Sebag

Learning Cellular Automata Rules for Pattern Reconstruction Task 240
Anna Piwonska and Franciszek Seredynski

Evolving Fuzzy Rules: Evaluation of a New Approach 250
Adam Ghandar, Zbigniew Michalewicz, and Frank Neumann

A Niched Genetic Programming Algorithm for Classification Rules Discovery in Geographic Databases 260
Marconi de Arruda Pereira, Clodoveu Augusto Davis Júnior, and João Antônio de Vasconcelos

Artificial Neural Network Modeling for Estimating the Depth of Penetration and Weld Bead Width from the Infra Red Thermal Image of the Weld Pool during A-TIG Welding 270
S. Chokkalingham, N. Chandrasekhar, and M. Vasudevan

Swarm Reinforcement Learning Method Based on an Actor-Critic Method 279
Hitoshi Iima and Yasuaki Kuroe

XCS Revisited: A Novel Discovery Component for the eXtended Classifier System 289
Nugroho Fredivianus, Holger Prothmann, and Hartmut Schmeck

Supplanting Neural Networks with ODEs in Evolutionary Robotics 299
Paul Grouchy and Gabriele M.T. D'Eleuterio

Parallel Distributed Implementation of Genetics-Based Machine Learning for Fuzzy Classifier Design 309
Yusuke Nojima, Shingo Mihara, and Hisao Ishibuchi

Multi-Objective Evolutionary Algorithms for Feature Selection: Application in Bankruptcy Prediction 319
António Gaspar-Cunha, Fernando Mendes, João Duarte, Armando Vieira, Bernardete Ribeiro, André Ribeiro, and João Neves

Tile Pasting P System with Multiple-Edge Pasting 329
T. Robinson, Atulya K. Nagar, and S. Jebasingh

Modeling and Automation of Diagnosis and Treatment of Diabetes 339
Abhirami Baskaran, Dhivya Karthikeyan, and Anusha T. Swamy

The Evolution of Fuzzy Classifier for Data Mining with Applications . . . 349
Václav Snášel, Pavel Krömer, Jan Platoš, and Ajith Abraham

PID Step Response Using Genetic Programming 359
Marcus Henrique Soares Mendes, Gustavo Luís Soares, and João Antônio de Vasconcelos

Divide and Evolve Driven by Human Strategies 369
Markus Borschbach, Christian Grelle, and Sascha Hauke

A Genetic Algorithm for Assigning Individuals to Populations Using Multi-locus Genotyping 374
Avnish K. Bhatia, Monika Sodhi, Dinesh K. Yadav, and B. Prakash

Extended Q-Learning Algorithm for Path-Planning of a Mobile Robot 379
Indrani Goswami (Chakraborty), Pradipta Kumar Das, Amit Konar, and R. Janarthanan

An XML Format for Sharing Evolutionary Algorithm Output and Analysis 384
Dharani Punithan, Jerome Marhic, Kangil Kim, Jakramate Bootkrajang, RI (Bob) McKay, and Naoki Mori

Car Setup Optimisation 389
Moisés Martínez, Gustavo Recio, Pablo García, Emilio Martín, and Yago Saez

Multi-Objective Evolutionary Algorithms and Applications

Robustness of Multi-objective Optimal Solutions to Physical Deterioration through Active Control 394
Gideon Avigad and Erella Eisenstadt

Non-dimensional Multi-objective Performance Optimization of Single Stage Thermoelectric Cooler 404
P.K.S. Nain, S. Sharma, and J.M. Giri

Multi-Objective Optimization of Particle Reinforced Silicone Rubber Mould Material for Soft Tooling Process 414
Arup Kumar Nandi and Shubhabrata Datta

Comparative Application of Multi-Objective Evolutionary Algorithms to the Voltage and Reactive Power Optimization Problem in Power Systems 424
S.B.D.V.P.S. Anauth and Robert T.F. Ah King

Bayesian Reliability Analysis under Incomplete Information Using Evolutionary Algorithms 435
Rupesh Kumar Srivastava and Kalyanmoy Deb

Optimisation of Double Wishbone Suspension System Using Multi-Objective Genetic Algorithm 445
Aditya Arikere, Gurunathan Saravana Kumar, and Sandipan Bandyopadhyay

Self-Controlling Dominance Area of Solutions in Evolutionary Many-Objective Optimization 455
Hiroyuki Sato, Hernán E. Aguirre, and Kiyoshi Tanaka

Optimum Design of Balanced SAW Filters Using Multi-Objective Differential Evolution 466
Kiyoharu Tagawa, Yukinori Sasaki, and Hiroyuki Nakamura

Optimizing the Risk of Occupational Health Hazard in a Multiobjective Decision Environment Using NSGA-II 476
Yogesh K. Anand, Sanjay Srivastava, and Kamal Srivastava

Tuning Process Parameters of Electrochemical Machining Using a Multi-objective Genetic Algorithm: A Preliminary Study 485
Dilip Datta and Akan Kumar Das

The Optimization versus Survival Problem and Its Solution by an Evolutionary Multi Objective Algorithm 494
Gideon Avigad, Erella Eisenstadt, and Miri Weiss

Synthesis of Difference Patterns for Monopulse Antenna Arrays – An Evolutionary Multi-objective Optimization Approach 504
Siddharth Pal, Aniruddha Basak, Swagatam Das, and P.N. Suganthan

Performance of Lognormal Probability Distribution in Crossover Operator of NSGA-II Algorithm 514
K.V.R.B. Prasad and Pravin M. Singru

Metamodels for Fast Multi-objective Optimization: Trading Off Global Exploration and Local Exploitation 523
Enrico Rigoni and Alessandro Turco

Integrated Location-Inventory Retail Supply Chain Design: A Multi-objective Evolutionary Approach 533
Shu-Hsien Liao and Chia-Lin Hsieh

Multi-Objective Job Shop Scheduling Based on Multiagent Evolutionary Algorithm 543
Xinrui Duan, Jing Liu, Li Zhang, and Licheng Jiao

A Preference Oriented Two-Layered Multiagent Evolutionary Algorithm for Multi-Objective Job Shop Problems 553
Xinrui Duan, Jing Liu, Ruochen Liu, and Licheng Jiao

Using an Adaptation of a Binary Search Tree to Improve the NSGA-II Nondominated Sorting Procedure 558
João Batista Mendes and João Antônio de Vasconcelos

A Hybrid Method for Multi-Objective Shape Optimization 563
G.N. Sashi Kumar, A.K. Mahendra, A. Sanyal, and G. Gouthaman

Evolutionary Multi-Objective Bacterial Swarm Optimization (MOBSO): A Hybrid Approach 568
Indranil Banerjee and Prasun Das

Multi-Objective Optimisation of Web Business Processes 573
Ashutosh Tiwari, Christopher Turner, Peter Ball, and Kostas Vergidis

Multi Objective Optimization of Planetary Gear Train 578
Vipin K. Tripathi and Hiten M. Chauhan

Multi-Objective Control Systems Design with Criteria Reduction 583
Piotr Woźniak

Probabilistic Based Evolutionary Optimizers in Bi-objective Travelling Salesman Problem 588
Vui Ann Shim, Kay Chen Tan, and Jun Yong Chia

Hybrid Algorithms

Automatic Shape Independent Shell Clustering Using an Ant Based Approach 593
Siddharth Pal, Aniruddha Basak, and Swagatam Das

Hybrid Search for Faster Production and Safer Process Conditions in Friction Stir Welding 603
Cem Celal Tutum, Kalyanmoy Deb, and Jesper Hattel

Hybrid Optimization Scheme for Radial Basis Function Neural Network 613
Vidyut Dey, Dilip Kumar Pratihar, and Gauranga Lal Datta

Modified Levenberg Marquardt Algorithm for Inverse Problems 623
Muthu Naveen, Shankar Jayaraman, Vinay Ramanath, and Shamik Chaudhuri

Constrained Engineering Design Optimization Using a Hybrid Bi-objective Evolutionary-Classical Methodology 633
Rituparna Datta

Industrial Applications

A Many-Objective Optimisation Decision-Making Process Applied to Automotive Diesel Engine Calibration 638
Robert J. Lygoe, Mark Cary, and Peter J. Fleming

A Modular Decision-Tree Architecture for Better Problem Understanding 647
Vineet R. Khare and Halasya Siva Subramania

Virtual Manufacturing Cell Design Using a PSO Approach with Alternative Neighbourhood Topologies 657
Rahul Caprihan, Jannes Slomp, Gursaran Srivastava, and Khushboo Agarwal

Energy Saving System for Office Lighting by Using PSO and ZigBee Network 667
Wa Si, Harutoshi Ogai, Tansheng Li, Masatoshi Ogawa, Katsumi Hirai, and Hidehiro Takahashi

EcoSupply: A Machine Learning Framework for Analyzing the Impact of Ecosystem on Global Supply Chain Dynamics 677
Vikas K. Garg and N. Viswanadham

A Data-Mining Method for Detection of Complex Nonlinear Relations Applied to a Model of Apoptosis in Cell Populations 687
Henrik Saxén and Frank Pettersson

An Implementation of Pareto Set Pursuing Technique for Concept Vehicle Design 696
Dhanesh Padmanabhan and Rajkumar Vaidyanathan

EPIC: Efficient Integration of Partitional Clustering Algorithms for Classification 706
Vikas K. Garg and M.N. Murty

Toward Optimal Disk Layout of Genome Scale Suffix Trees 711
Vikas K. Garg

Author Index 717