

*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 of Computer Science, Saarbruecken, Germany*

Paola Festa (Ed.)

# Experimental Algorithms

9th International Symposium, SEA 2010  
Ischia Island, Naples, Italy, May 20-22, 2010  
Proceedings



Springer

Volume Editor

Paola Festa  
Department of Mathematics and Applications  
University of Naples "Federico II"  
Compl. MSA  
Via Cintia  
80126 Naples, Italy  
E-mail: paola.festa@unina.it

Library of Congress Control Number: 2010926863

CR Subject Classification (1998): H.3, I.2, H.4, F.1, F.2, C.2

LNCS Sublibrary: SL 2 – Programming and Software Engineering

ISSN 0302-9743  
ISBN-10 3-642-13192-1 Springer Berlin Heidelberg New York  
ISBN-13 978-3-642-13192-9 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.com](http://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 proceedings volume contains the invited papers and the contributed papers accepted for presentation at the 9<sup>th</sup> International Symposium on Experimental Algorithms (SEA 2010), that was held at the Continental Terme Hotel, Ischia (Naples), Italy, during May 20–22, 2010.

Previous symposia of the series were held in Riga (2001), Monte Verita (2003), Rio de Janeiro (2004), Santorini (2005), Menorca (2006), Rome (2007), Cape Cod (2008), and Dortmund (2009).

Seventy-three papers were submitted by researchers from 19 countries. Each paper was reviewed by three experts among the Program Committee members and some trusted external referees. At least two reviewers were from the same or closely related discipline as the authors. The reviewers generally provided a high-quality assessment of the papers and often gave extensive comments to the authors for the possible improvement of the presentation. The submission and review process was supported by the ConfTool conference management software and we are thankful to Harald Weinreich for letting us use it.

The Program Committee selected 40 regular papers for presentation at the conference. In addition to the 40 contributed papers, this volume includes two invited papers related to corresponding keynote talks: Giuseppe F. Italiano (University of Rome “Tor Vergata,” Italy) spoke on “Experimental Study of Resilient Algorithms and Data Structures” and Panos M. Pardalos (University of Florida, USA) spoke on “Computational Challenges with Cliques, Quasi-Cliques and Clique Partitions in Graphs.”

Many people and organizations contributed to SEA 2010. We are particularly grateful for the patronage and financial support of the University of Naples “Federico II” and the Department of Mathematics and Applications “R. Caccioppoli,” and for the financial support of GNCS (Gruppo Nazionale per il Calcolo Scientifico) – INdAM (Istituto Nazionale di Alta Matematica).

We would like to thank all of the authors who responded to the call for papers submitting their scientific work. We express our sincere thanks to the invited speakers for their contributions to the program.

Our most sincere thanks go to the Program Committee members and the additional reviewers whose cooperation in carrying out quality reviews was critical for establishing a strong conference program.

We also sincerely thank Daniele Ferone for maintaining the symposium website (<http://www.sea2010.unina.it/>) and for his help in the organizing process.

I thank the SEA Steering Committee for giving me the opportunity to serve as the Program Chair and the responsibility to select the conference program. I am personally grateful to Jose Rolim, Giuseppe F. Italiano, Andrea Lodi, and

Andrew V. Goldberg for their support from the beginning to the final stage of the organization and for promptly answering my questions each time I needed their advice.

Finally, we thank Springer for publishing these proceedings in their prestigious *Lecture Notes in Computer Science* series, and in particular we would like to mention the fruitful and friendly cooperation with Alfred Hofmann and Anna Kramer during the preparation of this volume.

May 2010

Paola Festa

# Organization

SEA 2010 was organized by the Department of Mathematics and Applications “R. Caccioppoli,” University of Naples “Federico II.”

## Program Committee

David A. Bader

Massimo Benerecetti

Mark de Berg

Massimiliano Caramia

Ioannis Chatzigiannakis

David Coudert

Thomas Erlebach

Paola Festa (Chair)

Andrew Goldberg

Francesca Guerriero

Pierre Leone

Andrea Lodi

Catherine McGeoch

Ulrich Meyer

Rolf H. Möhring

Panos M. Pardalos

Jordi Petit

Helena Ramalhinho-Lourenço

Mauricio G.C. Resende

Celso C. Ribeiro

Adi Rosén

Andrea Schaerf

Anna Sciomachen

Marc Sevaux

Thomas Stützle

Éric Taillard

Dorothea Wagner

Peter Widmayer

Georgia Institute of Technology, USA

University of Naples “Federico II,” Italy

Technische Universiteit Eindhoven,

The Netherlands

University of Rome “Tor Vergata,” Italy

Research and Academic Computer

Technology Institute, Greece

Institut national de recherche en informatique  
et automatique, France

University of Leicester, United Kingdom

University of Naples “Federico II,” Italy

Microsoft Research, USA

University of Calabria, Italy

University of Geneva, Switzerland

University of Bologna, Italy

Amherst College, USA

Goethe University Frankfurt/Main, Germany

Technische Universität Berlin, Germany

University of Florida, USA

Universitat Politècnica de Catalunya, Spain

Universitat Pompeu Fabra, Spain

AT&T Labs Research, USA

Universidade Federal Fluminense, Brazil

Université Paris Sud, France

University of Udine, Italy

University of Genoa, Italy

Université de Bretagne-Sud, France

Université Libre de Bruxelles, Belgium

University of Applied Sciences of

Western Switzerland, Switzerland

University of Karlsruhe, Germany

Swiss Federal Institute of Technology

Zürich, Switzerland

## Steering Committee

Edoardo Amaldi	Politecnico di Milano, Italy
David A. Bader	Georgia Institute of Technology, USA
Josep Diaz	Universitat Politècnica de Catalunya, Spain
Giuseppe F. Italiano	University of Rome “Tor Vergata,” Italy
David Johnson	AT&T Labs Research, USA
Klaus Jansen	University of Kiel, Germany
Kurt Mehlhorn	Max-Planck-Institut für Informatik, Germany
Ian Munro	University of Waterloo, Canada
Sotiris Nikoletseas	University of Patras and CTI, Greece
Jose Rolim (Chair)	University of Geneva, Switzerland
Pavlos Spirakis	University of Patras and CTI, Greece

## Organizing Committee

Daniele Ferone	University of Naples “Federico II,” Italy
Paola Festa (Chair)	University of Naples “Federico II,” Italy

## Referees

Virat Agarwal	Juan Farré	Andrew Miller
Orestis Akribopoulos	Leonor Frias	Thomas Molhave
Edoardo Amaldi	Joaquim Gabarró	Carlos Oliveira
Enrico Angelelli	Clemente Galdi	Vitaly Osipov
Andreas Beckmann	Loukas Georgiadis	Apostolis Pyrgelis
Djamal Belazzougui	Karl Jiang	Mathieu Raffinot
Silvia Canale	Seunghwa Kang	Jason Riedy
Claude Chaudet	Christos Koninis	Frederic Roupin
Guojing Cong	Evangelos Kranakis	Salvador Roura
Anna Corazza	Xu Li	Vipin Sachdeva
Alexandre S. da Cunha	Xing Liu	Hanan Samet
Claudia D’Ambrosio	Michele Lombardi	Peter Sanders
Sanjeeb Dash	Zvi Lotker	Ricardo Silva
Daniel Dell’Osso	Matthias	Thomas Stidsen
Camil Demetrescu	Müller -Hannemann	Andrea Tramontani
David Ediger	Kamesh Madduri	Renato Werneck
Matthias Ehrgott	Enrico Malaguti	Christos Zaroliagis
Marco Faella	Othon Michail	

## Sponsoring Institutions

- Department of Mathematics and Applications “R. Caccioppoli”, University of Naples “Federico II,” Italy.
- GNCS (Gruppo Nazionale per il Calcolo Scientifico) - INdAM (Istituto Nazionale di Alta Matematica), Italy.

# Table of Contents

## Invited Papers

- Experimental Study of Resilient Algorithms and Data Structures ..... 1  
*Umberto Ferraro-Petrillo, Irene Finocchi, and Giuseppe F. Italiano*

- Computational Challenges with Cliques, Quasi-cliques and Clique  
Partitions in Graphs ..... 13  
*Panos M. Pardalos and Steffen Rebennack*

## Contributed Regular Papers

- Alternative Routes in Road Networks ..... 23  
*Ittai Abraham, Daniel Delling, Andrew V. Goldberg, and  
Renato F. Werneck*

- Fully Dynamic Speed-Up Techniques for Multi-criteria Shortest Path  
Searches in Time-Dependent Networks ..... 35  
*Annabell Berger, Martin Grimmer, and Matthias Müller-Hannemann*

- Space-Efficient SHARC-Routing ..... 47  
*Edith Brunel, Daniel Delling, Andreas Gemsa, and Dorothea Wagner*

- A New Fully Dynamic Algorithm for Distributed Shortest Paths and  
Its Experimental Evaluation ..... 59  
*Serafino Cicerone, Gianlorenzo D'Angelo, Gabriele Di Stefano,  
Daniele Frigioni, and Vinicio Maurizio*

- Contraction of Timetable Networks with Realistic Transfers ..... 71  
*Robert Geisberger*

- Distributed Time-Dependent Contraction Hierarchies ..... 83  
*Tim Kieritz, Dennis Luxen, Peter Sanders, and Christian Vetter*

- Practical Compressed Suffix Trees ..... 94  
*Rodrigo Cánovas and Gonzalo Navarro*

- Maximum Cliques in Protein Structure Comparison ..... 106  
*Noël Malod-Dognin, Rumen Andonov, and Nicola Yanev*

- Exact Bipartite Crossing Minimization under Tree Constraints ..... 118  
*Frank Baumann, Christoph Buchheim, and Frauke Liers*

- Bit-Parallel Search Algorithms for Long Patterns ..... 129  
*Branislav Ďurian, Hannu Peltola, Leena Salmela, and Jorma Tarhio*

Fast FPT Algorithms for Computing Rooted Agreement Forests: Theory and Experiments (Extended Abstract) . . . . .	141
<i>Chris Whidden, Robert G. Beiko, and Norbert Zeh</i>	
Experimental Evaluation of Approximation and Heuristic Algorithms for Sorting Railway Cars . . . . .	154
<i>Alain Hauser and Jens Maue</i>	
Time-Dependent Contraction Hierarchies and Approximation . . . . .	166
<i>Gernot Veit Batz, Robert Geisberger, Sabine Neubauer, and Peter Sanders</i>	
A New Combinational Logic Minimization Technique with Applications to Cryptology . . . . .	178
<i>Joan Boyar and René Peralta</i>	
Randomized Rounding for Routing and Covering Problems: Experiments and Improvements . . . . .	190
<i>Benjamin Doerr, Marvin Künnemann, and Magnus Wahlström</i>	
The Time Dependent Traveling Salesman Problem: Polyhedra and Branch-Cut-and-Price Algorithm . . . . .	202
<i>Hernán Abeledo, Ricardo Fukasawa, Artur Pessoa, and Eduardo Uchoa</i>	
An Approximate $\epsilon$ -Constraint Method for the Multi-objective Undirected Capacitated Arc Routing Problem . . . . .	214
<i>Lucio Grandinetti, Francesca Guerriero, Demetrio Laganà, and Ornella Pisacane</i>	
A Branch-and-Price Algorithm for Multi-mode Resource Leveling . . . . .	226
<i>Eamonn T. Coughlan, Marco E. Lübbecke, and Jens Schulz</i>	
Experiments with a Generic Dantzig-Wolfe Decomposition for Integer Programs . . . . .	239
<i>Gerald Gamrath and Marco E. Lübbecke</i>	
Using Bound Sets in Multiobjective Optimization: Application to the Biobjective Binary Knapsack Problem . . . . .	253
<i>Charles Delort and Olivier Spanjaard</i>	
Improving Cutting Plane Generation with 0-1 Inequalities by Bi-criteria Separation . . . . .	266
<i>Edoardo Amaldi, Stefano Coniglio, and Stefano Gualandi</i>	
New Lower Bounds for the Vehicle Routing Problem with Simultaneous Pickup and Delivery . . . . .	276
<i>Anand Subramanian, Eduardo Uchoa, and Luiz Satoru Ochi</i>	

A Metaheuristic for a Two Echelon Location-routing Problem .....	288
<i>Maurizio Boccia, Teodor G. Crainic, Antonio Sforza, and Claudio Sterle</i>	
New Fast Heuristics for the 2D Strip Packing Problem with Guillotine Constraint .....	302
<i>Minh Hoang Ha, François Clautiaux, Said Hanafi, and Christophe Wilbaut</i>	
An Experimental Comparison of Different Heuristics for the Master Bay Plan Problem .....	314
<i>Daniela Ambrosino, Davide Anghinolfi, Massimo Paolucci, and Anna Sciomachen</i>	
An Analysis of Heuristics for Vertex Colouring .....	326
<i>Marco Chiarandini and Thomas Stützle</i>	
Automatic Tuning of GRASP with Path-Relinking Heuristics with a Biased Random-key Genetic Algorithm .....	338
<i>Paola Festa, José F. Gonçalves, Mauricio G.C. Resende, and Ricardo M.A. Silva</i>	
Experiments with a Feasibility Pump Approach for Nonconvex MINLPs .....	350
<i>Claudia D'Ambrosio, Antonio Frangioni, Leo Liberti, and Andrea Lodi</i>	
Paging Multiple Users in Cellular Network: Yellow Page and Conference Call Problems .....	361
<i>Amotz Bar-Noy, Panagiotis Cheilaris, and Yi Feng</i>	
Realtime Classification for Encrypted Traffic .....	373
<i>Roni Bar-Yanai, Michael Langberg, David Peleg, and Liam Roditty</i>	
Data Propagation with Guaranteed Delivery for Mobile Networks .....	386
<i>Hakob Aslanyan, Pierre Leone, and Jose Rolim</i>	
Data Structures Resilient to Memory Faults: An Experimental Study of Dictionaries .....	398
<i>Umberto Ferraro-Petrillo, Fabrizio Grandoni, and Giuseppe F. Italiano</i>	
Experiments on Union-Find Algorithms for the Disjoint-Set Data Structure .....	411
<i>Md. Mostofa Ali Patwary, Jean Blair, and Fredrik Manne</i>	
Policy-Based Benchmarking of Weak Heaps and Their Relatives .....	424
<i>Asger Bruun, Stefan Edelkamp, Jyrki Katajainen, and Jens Rasmussen</i>	

Modularity-Driven Clustering of Dynamic Graphs .....	436
<i>Robert Görke, Pascal Maillard, Christian Staudt, and Dorothea Wagner</i>	
Gateway Decompositions for Constrained Reachability Problems .....	449
<i>Bastian Katz, Marcus Krug, Andreas Lochbihler, Ignaz Rutter, Gregor Snelting, and Dorothea Wagner</i>	
Robust and Efficient Delaunay Triangulations of Points on Or Close to a Sphere .....	462
<i>Manuel Caroli, Pedro M.M. de Castro, Sébastien Loriot, Olivier Rouiller, Monique Teillaud, and Camille Wormser</i>	
Fault Recovery in Wireless Networks: The Geometric Recolouring Approach .....	474
<i>Henk Meijer, Yurai Núñez-Rodríguez, and David Rappaport</i>	
Geometric Minimum Spanning Trees with GEOFILTERKRUSKAL .....	486
<i>Samidh Chatterjee, Michael Connor, and Piyush Kumar</i>	
Practical Nearest Neighbor Search in the Plane .....	501
<i>Michael Connor and Piyush Kumar</i>	
<b>Author Index .....</b>	<b>513</b>