

6th International Conference on Computability and Complexity in Analysis

CCA 2009, August 18–22, 2009, Ljubljana, Slovenia

Edited by

Andrej Bauer
Peter Hertling
Ker-I Ko



Editors

Andrej Bauer
Faculty of Mathematics and Physics
University of Ljubljana
Jadranska 21
1000 Ljubljana, Slovenia
andrej.bauer@andrej.com

Peter Hertling
Fakultät für Informatik
Universität der
Bundeswehr München
85577 Neubiberg, Germany
peter.hertling@unibw.de

Ker-I Ko
Department of Computer Science
State University of
New York at Stony Brook
Stony Brook, NY 11794-4400, USA
keriko@cs.sunysb.edu

ACM Classification 1998

G. Mathematics of Computing, F.2 Analysis of Algorithms and Problem Complexity

ISBN 978-3-939897-12-5

Published online and open access by

Schloss Dagstuhl – Leibniz-Center for Informatics GmbH, Dagstuhl Publishing, Saarbrücken/Wadern, Germany.

Publication date

November, 2009.

Bibliographic information published by the Deutsche Nationalbibliothek

The Deutsche Nationalbibliothek lists this publication in the Deutsche Nationalbibliografie; detailed bibliographic data are available in the Internet at <http://dnb.d-nb.de>.

License

This work is licensed under a Creative Commons Attribution-Noncommercial-No Derivative Works license: <http://creativecommons.org/licenses/by-nc-nd/3.0/legalcode>.



In brief, this license authorizes each and everybody to share (to copy, distribute and transmit) the work under the following conditions, without impairing or restricting the author's moral rights:

- Attribution: The work must be attributed to its authors.
- Noncommercial: The work may not be used for commercial purposes.
- No derivation: It is not allowed to alter or transform this work.

The copyright is retained by the corresponding authors.

Digital Object Identifier: 10.4230/OASlcs.CCA.2009.i

ISBN 978-3-939897-12-5

ISSN 2190-6807

<http://www.dagstuhl.de/oasics>

OASlcs – OpenAccess Series in Informatics

OASlcs aims at a suitable publication venue to publish peer-reviewed collections of papers emerging from a scientific event. OASlcs volumes are published according to the principle of Open Access, i.e., they are available online and free of charge.

ISSN 2190-6807

www.dagstuhl.de/oasics

**Proceedings of the
Sixth International
Conference on
Computability and
Complexity in Analysis**

CCA 2009

Ljubljana, Slovenia, August 18–22, 2009

Edited by:

Andrej Bauer, Peter Hertling, Ker-I Ko



Editors

Andrej Bauer
Faculty of Mathematics and Physics
University of Ljubljana
Jadranska 21
1000 Ljubljana, Slovenia
E-mail: andrej.bauer@andrej.com

Peter Hertling
Fakultät für Informatik
Universität der Bundeswehr München
85577 Neubiberg, Germany
E-mail: peter.hertling@unibw.de

Ker-I Ko
Department of Computer Science
State University of New York at Stony Brook
Stony Brook, NY 11794-4400, USA
E-mail: keriko@cs.sunysb.edu

Published by: Schloss Dagstuhl – Leibniz-Zentrum für Informatik
ISBN: 978-3-939897-12-5

Conference Organization

Program Committee

Andrej Bauer, *Ljubljana, Slovenia*
Vasco Brattka, *Cape Town, South Africa*
Mark Braverman, *Cambridge, USA*
Pieter Collins, *Amsterdam, The Netherlands*
Peter Hertling, *Munich, Germany*, co-chair
Hajime Ishihara, *Ishikawa, Japan*
Ker-I Ko, *Stony Brook, USA*, co-chair
Robert Rettinger, *Hagen, Germany*
Victor Selivanov, *Novosibirsk, Russia*
Alex Simpson, *Edinburgh, Great Britain*
Dieter Spreen, *Siegen, Germany*
Frank Stephan, *Singapore*
Xizhong Zheng, *Glenside, USA*

Organizing Committee

Andrej Bauer, chair
Iztok Kavkler
Davorin Lešnik
Matija Pretnar

Invited Speakers

Mark Braverman, *Cambridge, USA*
Vladik Kreinovich, *El Paso, USA*
Dana Scott, *Pittsburgh, USA*
Ning Zhong, *Cincinnati, USA*

Tutorials

Martín Escardó, *Birmingham, UK*
Bas Spitters and Russell O'Connor, *Eindhoven, The Netherlands*

Table of Contents

Conference Organization	iii
Table of Contents	iv
Author Index	vii
Preface	1
<i>Andrej Bauer, Peter Hertling, and Ker-I Ko</i>	
Invited Talks	
Computability and Complexity of Julia Sets (Invited Talk)	3
<i>Mark Braverman</i>	
From Interval Computations to Constraint-Related Set Computations: Towards Faster Estimation of Statistics and ODEs under Interval and p-Box Uncertainty (Invited Talk)	5
<i>Vladik Kreinovich</i>	
Semilattices, Domains, and Computability (Invited Talk)	17
<i>Dana Scott</i>	
Computable Analysis of Differential Equations (Invited Talk)	19
<i>Ning Zhong</i>	
Tutorials	
Theory and Practice of Higher-type Computation (Tutorial)	21
<i>Martín Escardó</i>	
Computer Verified Exact Analysis (Tutorial)	23
<i>Bas Spitters and Russell O'Connor</i>	
Contributed Papers	
Computing Conformal Maps onto Canonical Slit Domains	25
<i>Valentin V. Andreev and Timothy H. McNicholl</i>	
Canonical Effective Subalgebras of Classical Algebras as Constructive Metric Completions	37
<i>Andrej Bauer and Jens Blanck</i>	
Realisability and Adequacy for (Co)induction	49
<i>Ulrich Berger</i>	

A Constructive Study of Landau's Summability Theorem	61
<i>Josef Berger and Douglas Bridges</i>	
Separations of Non-monotonic Randomness Notions	71
<i>Laurent Bienvenu, Rupert Hölzl, Thorsten Kräling, and Wolfgang Merkle</i>	
Weihrauch Degrees, Omniscience Principles and Weak Computability	83
<i>Vasco Brattka and Guido Gherardi</i>	
Effective Choice and Boundedness Principles in Computable Analysis	95
<i>Vasco Brattka and Guido Gherardi</i>	
Computability of Homology for Compact Absolute Neighbourhood Retracts	107
<i>Pieter Collins</i>	
Σ_α^0 -Admissible Representations (Extended Abstract)	119
<i>Matthew de Brecht and Akihiro Yamamoto</i>	
Uniqueness, Continuity, and Existence of Implicit Functions in Constructive Analysis	131
<i>Hannes Diener and Peter Schuster</i>	
Relativizations of the P =? DNP Question for the BSS Model	141
<i>Christine Gaßner</i>	
Curves That Must Be Retraced	149
<i>Xiaoyang Gu, Jack H. Lutz, Elvira Mayordomo</i>	
Effective Dispersion in Computable Metric Spaces	161
<i>Zvonko Iljazović</i>	
On Oscillation-free ε -random Sequences II	173
<i>Jöran Mielke and Ludwig Staiger</i>	
Computability of Probability Distributions and Distribution Functions . . .	185
<i>Takakazu Mori, Yoshiki Tsujii, and Mariko Yasugi</i>	
How Discontinuous is Computing Nash Equilibria? (Extended Abstract) .	197
<i>Arno Pauly</i>	
Towards the Complexity of Riemann Mappings (Extended Abstract)	209
<i>Robert Rettinger</i>	
On the Computability of Rectifiable Simple Curve (Extended Abstract) .	221
<i>Robert Rettinger and Xizhong Zheng</i>	

A Note on Closed Subsets in Quasi-zero-dimensional Qcb-spaces (Extended Abstract)	233
<i>Matthias Schröder</i>	
Random Iteration Algorithm for Graph-Directed Sets	245
<i>Yoshiki Tsujii, Takakazu Mori, Mariko Yasugi, and Hideki Tsuiki</i>	
Computable Separation in Topology, from \mathbf{T}_0 to \mathbf{T}_3	257
<i>Klaus Weihrauch</i>	
Real Computation with Least Discrete Advice: A Complexity Theory of Nonuniform Computability	269
<i>Martin Ziegler</i>	

Author Index

- Andreev, Valentin V. 25
- Bauer, Andrej 37
Berger, Josef 61
Berger, Ulrich 49
Bienvenu, Laurent 71
Blanck, Jens 37
Brattka, Vasco 83, 95
Braverman, Mark 3
Bridges, Douglas 61
- Collins, Pieter 107
- de Brecht, Matthew 119
Diener, Hannes 131
- Escardó, Martín 21
- Gaßner, Christine 141
Gherardi, Guido 83, 95
Gu, Xiaoyang 149
- Hölzl, Rupert 71
- Iljazović, Zvonko 161
- Kräling, Thorsten 71
Kreinovich, Vladik 5
- Lutz, Jack H. 149
- Mayordomo, Elvira 149
McNicholl, Timothy H. 25
Merkle, Wolfgang 71
Mielke, Jöran 173
Mori, Takakazu 185, 245
- O'Connor, Russell 23
- Pauly, Arno 197
- Rettinger, Robert 209, 221
- Schröder, Matthias 233
Schuster, Peter 131
Scott, Dana 17
Spitter, Bas 23
Staiger, Ludwig 173
- Tsuiki, Hideki 245
Tsuji, Yoshiki 185, 245
- Weihrauch, Klaus 257
- Yamamoto, Akihiro 119
Yasugi, Mariko 185, 245
- Zheng, Xizhong 221
Zhong, Ning 19
Ziegler, Martin 269