

30th Conference on Computational Complexity

CCC'15, June 17-19, 2015, Portland, Oregon, USA

Edited by

David Zuckerman



Editor

David Zuckerman
Department of Computer Science
University of Texas at Austin
2317 Speedway, Stop D9500
Austin, Texas 78712
USA
diz@cs.utexas.edu

ACM Classification 1998
F. Theory of Computation

ISBN 978-3-939897-81-1

Published online and open access by

Schloss Dagstuhl – Leibniz-Zentrum für Informatik GmbH, Dagstuhl Publishing, Saarbrücken/Wadern, Germany. Online available at <http://www.dagstuhl.de/dagpub/978-3-939897-81-1>.

Publication date

June, 2015

Bibliographic information published by the Deutsche Nationalbibliothek

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

License

This work is licensed under a Creative Commons Attribution 3.0 Unported license (CC-BY 3.0): <http://creativecommons.org/licenses/by/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 authors' moral rights:

- Attribution: The work must be attributed to its authors.

The copyright is retained by the corresponding authors.

Digital Object Identifier: 10.4230/LIPIcs.CCC.2015.i

ISBN 978-3-939897-81-1

ISSN 1868-8969

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

LIPICs – Leibniz International Proceedings in Informatics

LIPICs is a series of high-quality conference proceedings across all fields in informatics. LIPICs volumes are published according to the principle of Open Access, i.e., they are available online and free of charge.

Editorial Board

- Susanne Albers (TU München)
- Chris Hankin (Imperial College London)
- Deepak Kapur (University of New Mexico)
- Michael Mitzenmacher (Harvard University)
- Madhavan Mukund (Chennai Mathematical Institute)
- Catuscia Palamidessi (INRIA)
- Wolfgang Thomas (*Chair*, RWTH Aachen)
- Pascal Weil (CNRS and University Bordeaux)
- Reinhard Wilhelm (Saarland University)

ISSN 1868-8969

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

■ Contents

Preface	
<i>David Zuckerman</i>	vii
Awards	
.....	ix
Conference Organization	
.....	xi
External Reviewers	
.....	xiii

Contributed Papers

Strong Locally Testable Codes with Relaxed Local Decoders	
<i>Oded Goldreich, Tom Gur, and Ilan Komargodski</i>	1
An Entropy Sunset Inequality and Polynomially Fast Convergence to Shannon Capacity Over All Alphabets	
<i>Venkatesan Guruswami and Ameya Velingker</i>	42
The List-Decoding Size of Fourier-Sparse Boolean Functions	
<i>Ishay Haviv and Oded Regev</i>	58
Nonclassical Polynomials as a Barrier to Polynomial Lower Bounds	
<i>Abhishek Bhowmick and Shachar Lovett</i>	72
Simplified Lower Bounds on the Multiparty Communication Complexity of Disjointness	
<i>Anup Rao and Amir Yehudayoff</i>	88
How to Compress Asymmetric Communication	
<i>Sivaramakrishnan Natarajan Ramamoorthy and Anup Rao</i>	102
Majority is Incompressible by $AC^0[p]$ Circuits	
<i>Igor Carboni Oliveira and Rahul Santhanam</i>	124
Lower Bounds for Depth Three Arithmetic Circuits with Small Bottom Fanin	
<i>Neeraj Kayal and Chandan Saha</i>	158
A Depth-Five Lower Bound for Iterated Matrix Multiplication	
<i>Suman K. Bera and Amit Chakrabarti</i>	183
Factors of Low Individual Degree Polynomials	
<i>Rafael Oliveira</i>	198
Verifiable Stream Computation and Arthur-Merlin Communication	
<i>Amit Chakrabarti, Graham Cormode, Andrew McGregor, Justin Thaler, and Suresh Venkatasubramanian</i>	217
Identifying an Honest EXP^{NP} Oracle Among Many	
<i>Shuichi Hirahara</i>	244

30th Conference on Computational Complexity (CCC'15).

Editor: David Zuckerman



Leibniz International Proceedings in Informatics
Schloss Dagstuhl – Leibniz-Zentrum für Informatik, Dagstuhl Publishing, Germany

Adaptivity Helps for Testing Juntas <i>Rocco A. Servedio, Li-Yang Tan, and John Wright</i>	264
A Characterization of Hard-to-cover CSPs <i>Amey Bhangale, Prahladh Harsha, and Girish Varma</i>	280
Subexponential Size Hitting Sets for Bounded Depth Multilinear Formulas <i>Rafael Oliveira, Amir Shpilka, and Ben Lee Volk</i>	304
Deterministic Identity Testing for Sum of Read-once Oblivious Arithmetic Branching Programs <i>Rohit Gurjar, Arpita Korwar, Nitin Saxena, and Thomas Thierauf</i>	323
Kolmogorov Width of Discrete Linear Spaces: an Approach to Matrix Rigidity <i>Alex Samorodnitsky, Ilya Shkredov, and Sergey Yekhanin</i>	347
On the (Non) NP-Hardness of Computing Circuit Complexity <i>Cody D. Murray and R. Ryan Williams</i>	365
Circuits with Medium Fan-In <i>Pavel Hrubeš and Anup Rao</i>	381
Correlation Bounds Against Monotone NC ¹ <i>Benjamin Rossman</i>	392
Non-Commutative Formulas and Frege Lower Bounds: a New Characterization of Propositional Proofs <i>Fu Li, Iddo Tzameret, and Zhengyu Wang</i>	412
The Space Complexity of Cutting Planes Refutations <i>Nicola Galesi, Pavel Pudlák, and Neil Thapen</i>	433
Tight Size-Degree Bounds for Sums-of-Squares Proofs <i>Massimo Lauria and Jakob Nordström</i>	448
A Generalized Method for Proving Polynomial Calculus Degree Lower Bounds <i>Mladen Mikša and Jakob Nordström</i>	467
Generalized Quantum Arthur-Merlin Games <i>Hirota Kobayashi, François Le Gall, and Harumichi Nishimura</i>	488
Parallel Repetition for Entangled k -player Games via Fast Quantum Search <i>Kai-Min Chung, Xiaodi Wu, and Henry Yuen</i>	512
Upper Bounds on Quantum Query Complexity Inspired by the Elitzur-Vaidman Bomb Tester <i>Cedric Yen-Yu Lin and Han-Hsuan Lin</i>	537
A Polylogarithmic PRG for Degree 2 Threshold Functions in the Gaussian Setting <i>Daniel M. Kane</i>	567
Incompressible Functions, Relative-Error Extractors, and the Power of Nondeterministic Reductions (Extended Abstract) <i>Benny Applebaum, Sergei Artemenko, Ronen Shaltiel, and Guang Yang</i>	582
On Randomness Extraction in AC ⁰ <i>Oded Goldreich, Emanuele Viola, and Avi Wigderson</i>	601

■ Preface

The papers in this volume were accepted for presentation at the 30th Computational Complexity Conference (CCC'15), held June 17–19, 2015 in Portland, Oregon as part of the ACM Federated Computing Research Conference (FCRC'15). The conference is organized by the Computational Complexity Foundation in cooperation with the European Association for Theoretical Computer Science (EATCS) and the ACM Special Interest Group on Algorithms and Computation Theory (SIGACT). CCC'15 is sponsored by Microsoft Research and is supported by the Institute for Quantum Computing (IQC).

The call for papers sought original research papers in all areas of computational complexity theory. Of the 110 submissions the program committee selected 30 for presentation at the conference.

The program committee would like to thank everyone involved in the conference, including all those who submitted papers for consideration as well as the reviewers (listed separately) for their scientific contributions; the board of trustees of the Computational Complexity Foundation and especially its president Dieter van Melkebeek for extensive advice and assistance; Jacobo Toran for a variety of assistance; Mike Saks for sharing his knowledge as 2014 PC chair; and Marc Herbstritt for coordinating the production of these proceedings.

David Zuckerman
Program Committee Chair



■ Awards

The program committee of the 30th Computational Complexity Conference is happy to present the 2015 Best Paper Award to Benjamin Rossman for his paper

“Correlation Bounds Against Monotone NC^1 ,”

and the 2015 Best Student Paper Award to Rafael Oliveira for his paper

“Factors of Low Individual Degree Polynomials.”

Funding for the best student paper award is provided by the European Association for Theoretical Computer Science (EATCS).



■ Conference Organization

Program Committee

Andris Ambainis, University of Latvia
Andrej Bogdanov, Chinese University of Hong Kong
Andrew Drucker, University of Edinburgh
Zeev Dvir, Princeton University
Parikshit Gopalan, Microsoft
Johan Håstad, KTH, Stockholm
Russell Impagliazzo, University of California, San Diego
Prasad Raghavendra, University of California, Berkeley
Ran Raz, Weizmann Institute & IAS
Shubhangi Saraf, Rutgers University
David Zuckerman (chair), University of Texas at Austin

FCRC Liaison

Dieter van Melkebeek, University of Wisconsin-Madison

Board of Trustees

Eric Allender (Treasurer), Rutgers University
Venkatesan Guruswami, Carnegie Mellon University
Jeff Kinne (Secretary), Indiana State University
Dieter van Melkebeek (President), University of Wisconsin-Madison
Madhu Sudan, Microsoft Research New England
Jacob Toran, University of Ulm
Osamu Watanabe, Tokyo Institute of Technology



■ External Reviewers

Alex Arkhipov	Per Austrin	Raef Bassily
Salman Beigi	Aleksandrs Belovs	Arnab Bhattacharyya
Abhishek Bhowmick	Eric Blais	Fernando Brandao
Vladimir Braverman	Jop Briet	Joshua Brody
Christina Brzuska	Andre Chailloux	Sourav Chakraborty
Siu On Chan	Xi Chen	Kai-Min Chung
Julia Chuzhoy	Constantinos Daskalakis	Anindya De
Javier Esparza	Will Evans	Omar Fawzi
Yuval Filmus	Michael Forbes	Ariel Gabizon
Nicola Galesi	Ankit Garg	Sivakanth Gopi
Alan Gou	Joao Gouveia	Siyao Guo
Aram Harrow	Prahladh Harsha	Sangxia Huang
Christian Ikenmeyer	Janis Iraids	Erich Kaltofen
Michael Kapralov	Tali Kaufman	Akinori Kawachi
Subhash Khot	Hartmut Klauck	Gillat Kol
Swastik Kopparty	Ravi Kumar	Massimo Lauria
Chin Ho Lee	Troy Lee	Nikos Leonardos
Satyanarayana Lokam	Shachar Lovett	Laura Mancinska
Raghu Meka	Mladen Miksa	Tomoyuki Morimae
Dana Moshkovitz	Daniel Nagaj	Chandra Nair
Hariharan Narayanan	Jakob Nordstrom	Ryan O'Donnell
Toni Pitassi	Sebastian Pokutta	Igor Razgon
Oded Regev	Silas Richelson	Aviad Rubinstein
Rahul Santhanam	Giannicola Scarpa	Rocco Servedio
Alexander Sherstov	Seung Woo Shin	Srikanth Srinivasan
Piyush Srivastava	David Steurer	Howard Straubing
Ido Tal	Li-Yang Tan	Luca Trevisan
Hing Yin Tsang	Salil Vadhan	Greg Valiant
Dieter van Melkebeek	Thomas Vidick	Jevgenijs Vihrovs
Marc Vinyals	Emanuele Viola	Ben Lee Volk
Carol Wang	Osamu Watanabe	John Watrous
Thomas Watson	Omri Weinstein	Ryan Williams
Karl Wimmer	John Wright	Sergey Yekhanin
Ke Yi	Shengyu Zhang	



