

36th Computational Complexity Conference

CCC 2021, July 20–23, 2021, Toronto, Ontario, Canada
(Virtual Conference)

Edited by

Valentine Kabanets



Editors

Valentine Kabanets

School of Computing Science
Simon Fraser University
Burnaby, BC
Canada
kabanets@cs.sfu.ca

ACM Classification 2012

Theory of computation

ISBN 978-3-95977-193-1

Published online and open access by

Schloss Dagstuhl – Leibniz-Zentrum für Informatik GmbH, Dagstuhl Publishing, Saarbrücken/Wadern, Germany. Online available at <https://www.dagstuhl.de/dagpub/978-3-95977-193-1>.

Publication date

July, 2021

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 <https://portal.dnb.de>.

License

This work is licensed under a Creative Commons Attribution 4.0 International license (CC-BY 4.0): <https://creativecommons.org/licenses/by/4.0/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.2021.0

ISBN 978-3-95977-193-1

ISSN 1868-8969

<https://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

- Luca Aceto (*Chair*, Reykjavik University, IS and Gran Sasso Science Institute, IT)
- Christel Baier (TU Dresden, DE)
- Mikolaj Bojanczyk (University of Warsaw, PL)
- Roberto Di Cosmo (Inria and Université de Paris, FR)
- Faith Ellen (University of Toronto, CA)
- Javier Esparza (TU München, DE)
- Daniel Král' (Masaryk University - Brno, CZ)
- Meena Mahajan (Institute of Mathematical Sciences, Chennai, IN)
- Anca Muscholl (University of Bordeaux, FR)
- Chih-Hao Luke Ong (University of Oxford, GB)
- Phillip Rogaway (University of California, Davis, US)
- Eva Rotenberg (Technical University of Denmark, Lyngby, DK)
- Raimund Seidel (Universität des Saarlandes, Saarbrücken, DE and Schloss Dagstuhl – Leibniz-Zentrum für Informatik, Wadern, DE)

ISSN 1868-8969

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

■ Contents

Preface	
<i>Valentine Kabanets</i>	0:ix
Awards	
.....	0:xi
Conference Organization	
.....	0:xiii
External Reviewers	
.....	0:xv

Papers

Rate Amplification and Query-Efficient Distance Amplification for Linear LCC and LDC	
<i>Gil Cohen and Tal Yankovitz</i>	1:1–1:57
An Improved Protocol for the Exactly- N Problem	
<i>Nati Linial and Adi Shraibman</i>	2:1–2:8
Proof Complexity of Natural Formulas via Communication Arguments	
<i>Dmitry Itsykson and Artur Riazanov</i>	3:1–3:34
A Lower Bound on Determinantal Complexity	
<i>Mrinal Kumar and Ben Lee Volk</i>	4:1–4:12
Optimal Tiling of the Euclidean Space Using Permutation-Symmetric Bodies	
<i>Mark Braverman and Dor Minzer</i>	5:1–5:48
On the Power and Limitations of Branch and Cut	
<i>Noah Fleming, Mika Göös, Russell Impagliazzo, Toniann Pitassi, Robert Robere, Li-Yang Tan, and Avi Wigderson</i>	6:1–6:30
Separating ABPs and Some Structured Formulas in the Non-Commutative Setting	
<i>Prerona Chatterjee</i>	7:1–7:24
The (Generalized) Orthogonality Dimension of (Generalized) Kneser Graphs: Bounds and Applications	
<i>Alexander Golovnev and Ishay Haviv</i>	8:1–8:15
Shadows of Newton Polytopes	
<i>Pavel Hrubeš and Amir Yehudayoff</i>	9:1–9:23
Fractional Pseudorandom Generators from Any Fourier Level	
<i>Eshan Chattopadhyay, Jason Gaitonde, Chin Ho Lee, Shachar Lovett, and Abhishek Shetty</i>	10:1–10:24
Deterministic Identity Testing Paradigms for Bounded Top-Fanin Depth-4 Circuits	
<i>Pranjal Dutta, Prateek Dwivedi, and Nitin Saxena</i>	11:1–11:27



Robustly Self-Ordered Graphs: Constructions and Applications to Property Testing <i>Oded Goldreich and Avi Wigderson</i>	12:1–12:74
Barriers for Recent Methods in Geodesic Optimization <i>W. Cole Franks and Philipp Reichenbach</i>	13:1–13:54
Communication Complexity with Defective Randomness <i>Marshall Ball, Oded Goldreich, and Tal Malkin</i>	14:1–14:10
On the Cut Dimension of a Graph <i>Troy Lee, Tongyang Li, Miklos Santha, and Shengyu Zhang</i>	15:1–15:35
On p -Group Isomorphism: Search-To-Decision, Counting-To-Decision, and Nilpotency Class Reductions via Tensors <i>Joshua A. Grochow and Youming Qiao</i>	16:1–16:38
Branching Programs with Bounded Repetitions and Flow Formulas <i>Anastasia Sofronova and Dmitry Sokolov</i>	17:1–17:25
A Majority Lemma for Randomised Query Complexity <i>Mika Göös and Gilbert Maystre</i>	18:1–18:15
Hitting Sets and Reconstruction for Dense Orbits in VP_e and $\Sigma\Pi\Sigma$ Circuits <i>Dori Medini and Amir Shpilka</i>	19:1–19:27
Variety Evasive Subspace Families <i>Zeyu Guo</i>	20:1–20:33
A Lower Bound for Polynomial Calculus with Extension Rule <i>Yaroslav Alekseev</i>	21:1–21:18
Error Reduction for Weighted PRGs Against Read Once Branching Programs <i>Gil Cohen, Dean Doron, Oren Renard, Ori Sberlo, and Amnon Ta-Shma</i>	22:1–22:17
A Stress-Free Sum-Of-Squares Lower Bound for Coloring <i>Pravesh K. Kothari and Peter Manohar</i>	23:1–23:21
Junta Distance Approximation with Sub-Exponential Queries <i>Vishnu Iyer, Avishay Tal, and Michael Whitmeyer</i>	24:1–24:38
Arithmetic Circuit Complexity of Division and Truncation <i>Pranjal Dutta, Gorav Jindal, Anurag Pandey, and Amit Sinhababu</i>	25:1–25:36
SOS Lower Bound for Exact Planted Clique <i>Shuo Pang</i>	26:1–26:63
A Direct Product Theorem for One-Way Quantum Communication <i>Rahul Jain and Srijita Kundu</i>	27:1–27:28
Quantum Complexity of Minimum Cut <i>Simon Apers and Troy Lee</i>	28:1–28:33
On the Complexity of Evaluating Highest Weight Vectors <i>Markus Bläser, Julian Dörfler, and Christian Ikenmeyer</i>	29:1–29:36
On Query-To-Communication Lifting for Adversary Bounds <i>Anurag Anshu, Shalev Ben-David, and Srijita Kundu</i>	30:1–30:39

Hardness of Constant-Round Communication Complexity <i>Shuichi Hirahara, Rahul Ilango, and Bruno Loff</i>	31:1–31:30
Polynomial Time Algorithms in Invariant Theory for Torus Actions <i>Peter Bürgisser, M. Levent Doğan, Visu Makam, Michael Walter, and Avi Wigderson</i>	32:1–32:30
Pseudodistributions That Beat All Pseudorandom Generators (Extended Abstract) <i>Edward Pyne and Salil Vadhan</i>	33:1–33:15
GSF-Locality Is Not Sufficient For Proximity-Oblivious Testing <i>Isolde Adler, Noleen Köhler, and Pan Peng</i>	34:1–34:27
Hardness of KT Characterizes Parallel Cryptography <i>Hanlin Ren and Rahul Santhanam</i>	35:1–35:58
On the Pseudo-Deterministic Query Complexity of NP Search Problems <i>Shafi Goldwasser, Russell Impagliazzo, Toniann Pitassi, and Rahul Santhanam</i> ...	36:1–36:22
A Simple Proof of a New Set Disjointness with Applications to Data Streams <i>Akshay Kamath, Eric Price, and David P. Woodruff</i>	37:1–37:24
Toward Better Depth Lower Bounds: The XOR-KRW Conjecture <i>Ivan Mihajlin and Alexander Smal</i>	38:1–38:24
Fourier Growth of Parity Decision Trees <i>Uma Girish, Avishay Tal, and Kewen Wu</i>	39:1–39:36
The Power of Negative Reasoning <i>Susanna F. de Rezende, Massimo Lauria, Jakob Nordström, and Dmitry Sokolov</i>	40:1–40:24
Matrix Rigidity Depends on the Target Field <i>László Babai and Bohdan Kivva</i>	41:1–41:26

■ Preface

The papers in this volume were accepted for presentation at the 36th Computational Complexity Conference (CCC 2021), held between July 20–22, 2021, in a virtual online format. CCC 2021 was originally scheduled to be held in Toronto, Canada, but due to the public health measures related to Covid-19 still in place, the online format was used instead. The conference is organized by the Computational Complexity Foundation (CCF) in cooperation with the ACM Special Interest Group on Algorithms and Computation Theory (SIGACT) and the European Association for Theoretical Computer Science (EATCS).

The call for papers sought original research papers in all areas of computational complexity theory. Of the 116 submissions, the program committee selected 41 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 Venkatesan Guruswami, and secretary Ashwin Nayak for their advice and assistance; Shubhangi Saraf for sharing her knowledge as prior PC chair for CCC; the Local Arrangements Committee chair Benjamin Rossman; Eric Allender for the invited talk; Meena Mahajan for her help with the submission server setup and editing of the proceedings; and Michael Wagner for coordinating the production of these proceedings.

Valentine Kabanets

Program Committee Chair, on behalf of the Program Committee



■ Awards

The program committee of the 36th Computational Complexity Conference is very pleased to present the **Best Student Paper Award** to Yaroslav Alekseev for his paper

A Lower Bound for Polynomial Calculus with Extension Rule.



■ Conference Organization

Program Committee

Arkadev Chattopadhyay, Tata Institute of Fundamental Research Mumbai
Irit Dinur, Weizmann Institute of Science
Yuval Ishai, Technion
Valentine Kabanets (Chair), Simon Fraser University
Swastik Kopparty, Rutgers University
Nutan Limaye, Indian Institute of Technology Bombay
Ryan O'Donnell, Carnegie Mellon University
Igor Carboni Oliveira, University of Warwick
Alexander Razborov, University of Chicago/Steklov Institute
Barna Saha, University of California Berkeley
Emanuele Viola, Northeastern University
Henry Yuen, University of Toronto/Columbia University

Local Arrangements Committee

Aleksandar Nikolov, University of Toronto
Benjamin Rossman (Chair), Duke University
Sushant Sachdeva, University of Toronto
Henry Yuen, University of Toronto/Columbia University

Board of Trustees

Venkatesan Guruswami (President), Carnegie Mellon University
Michal Koucký, Charles University
Shachar Lovett, University of California at San Diego
Meena Mahajan, The Institute of Mathematical Sciences
Pierre McKenzie, Université de Montréal
Ashwin Nayak, University of Waterloo
Rahul Santhanam, Oxford University
Ronen Shaltiel, University of Haifa
Ryan Williams, Massachusetts Institute of Technology



External Reviewers

Eric Allender	Josh Alman	Robert Andrews
Sepehr Assadi	Paul Beame	Shalev Ben-David
Amey Bhangale	Vishwas Bhargava	Vijay Bhattiprolu
Markus Bläser	Ilario Bonacina	Joshua Brody
Peter BuerGISser	Boris Bukh	Marco Carmosino
Bruno Cavalari	Amit Chakrabarti	Diptarka Chakraborty
Eshan Chattopadhyay	Prasad Chaugule	Xi Chen
Ashish Chiplunkar	Gil Cohen	Daniel Dadush
Mina Dalirrooyfard	Anindya De	Rafael Mendes de Oliveira
Susanna F. de Rezende	Ronald de Wolf	Holger Dell
Talya Eden	Yuval Filmus	Noah Fleming
Michael Forbes	Cole Franks	Bin Fu
Abdul Ghani	Sumanta Ghosh	Leslie Ann Goldberg
Alexander Golovnev	Sivakanth Gopi	Joshua Grochow
Tom Gur	Rohit Gurjar	Shuichi Hirahara
Samuel Hopkins	William Hoza	Pavel Hrubes
Hsin-Yuan Huang	Xuanguang Huang	Yichen Huang
Christian Ikenmeyer	Rahul Ilango	Peter Ivanov
Gabor Ivanyos	Mark Jerrum	C.S. Karthik
Sanjeev Khanna	Alexander Knop	Pascal Koiran
Antonina Kolokolova	Sajin Koroth	Robin Kothari
Michal Koucky	Mrinal Kumar	Dmitriy Kunisky
Chin Ho Lee	Tongyang Li	Xin Li
Andrea Lincoln	Bruno Loff	Zhenjian Lu
Joshua Maglione	Meena Mahajan	Guillaume Malod
Or Meir	Ian Mertz	Sidhanth Mohanty
Chandra Kanta Mohapatra	Jonathan Mosheiff	Partha Mukhopadhyay
Sagnik Mukhopadhyay	Ashwin Nayak	Rafael Oliveira
Shuo Pang	Fahad Panolan	Fedor Part
Shir Peleg	Stephen Piddock	Aaron Potechin
Aditya Potukuchi	Kevin Pratt	Pavel Pudlak
Jaikumar Radhakrishnan	Akshay Ramachandran	Shravas Rao
Ran Raz	Nicolas Resch	David Richerby
Robert Robere	Dana Ron	Noga Ron-Zewi
Chandan Saha	Rahul Santhanam	Swagato Sanyal
Ramprasad Saptharishi	Will Sawin	Nitin Saxena
Gil Segev	Ronen Shaltiel	Suhail Sherif
Alexander Sherstov	Igor Shinkar	Amir Shpilka
Adi Shraibman	Makrand Sinha	Amit Sinhababu
Dmitry Sokolov	Srikanth Srinivasan	Manuel Stoeckl
Xiaoming Sun	Xiaorui Sun	Avishay Tal
Till Tantau	Sébastien Tavenas	Anamay Tengse
Raghunath Tewari	Samarth Tiwari	Iddo Zameret
Marc Vinyals	Ben Lee Volk	Ilya Volkovich

0:xvi External Reviewers

Nikhil Vyas
Jinshan Wu
Huacheng Yu

S. Matthew Weinberg
Penghui Yao
Uri Zwick

James Wilson
Yuichi Yoshida