

Jeroen Zuiddam

Curriculum vitae

August 31, 2022

1. Personal information

Contact information:

Korteweg–de Vries Institute for Mathematics
University of Amsterdam
Science Park 107
1098 XG Amsterdam
The Netherlands
<https://staff.fnwi.uva.nl/j.zuiddam/>
j.zuiddam@uva.nl

Personal information:

Born on January 18, 1991 in Leiderdorp, Netherlands

2. Research interests

Computational complexity theory, algebraic complexity theory, tensors, matrix multiplication algorithms, quantum information theory, entanglement, communication complexity, discrete mathematics and graph theory, Shannon capacity of graphs, representation theory, algebraic geometry, semi-algebraic geometry, combinatorial optimization

3. Education

- 2018 PhD, Mathematics and Computer Science, *cum laude*, University of Amsterdam
- 2014 MSc Mathematics, *cum laude*, University of Amsterdam
- 2012 BSc Mathematics, *cum laude*, University of Amsterdam
BSc Computer Science, *cum laude*, University of Amsterdam

4. Professional appointment

- 2021 – Assistant Professor, Korteweg–de Vries Institute for Mathematics, University of Amsterdam
- 2020 – 2021 Simons Junior Fellow, Courant Institute, New York University, NY, hosted by Oded Regev
- 2018 – 2020 Postdoctoral member, School of Mathematics, Institute for Advanced Study, Princeton, NJ, hosted by Avi Wigderson
- 2014 – 2018 PhD student, Centrum Wiskunde & Informatica, Amsterdam, supervised by Harry Buhrman.

5. Grants and Fellowships

- 2022 CRM–Simons Professorship at the Centre de Recherches Mathématiques, Simons Foundation, November 2022
- 2021 NWO Veni Grant (€280.000 \approx \$314.000), Dutch Research Council NWO
- 2020 Simons Junior Fellowship (\$409.179), Simons Society of Fellows, Simons Foundation

6. Scientific publication

6.1. PhD thesis

Algebraic complexity, asymptotic spectra and entanglement polytopes,
University of Amsterdam, October 2018

Advisors: Harry Buhrman and Matthias Christandl

<https://hdl.handle.net/11245.1/9a8030e9-f708-4c95-9d50-f2a5919e75ed>

6.2. Scientific journals

1. J. Zuiddam, *A note on the gap between rank and border rank*, Linear Algebra and its Applications, 2017
arxiv:1504.05597, doi:10.1016/j.laa.2017.03.015
2. J. Briët and J. Zuiddam, *On the orthogonal rank of Cayley graphs and impossibility of quantum round elimination*, Quantum Information and Computation, 2017
arxiv:1608.06113, <http://www.rintonpress.com/xxqic17/qic-17-12/0106-0116.pdf>
3. H. Buhrman, M. Christandl, C. Perry and J. Zuiddam, *Clean quantum and classical communication protocols*, Physical Review Letters, 2016
arxiv:1605.07948, doi:10.1103/PhysRevLett.117.230503
4. M. Christandl, A.K. Jensen and J. Zuiddam, *Tensor rank is not multiplicative under the tensor product*, Linear Algebra and its Applications, 2018
arxiv:1705.09379, doi:10.1016/j.laa.2017.12.020
5. M. Christandl and J. Zuiddam, *Tensor surgery and tensor rank*, Computational complexity, 2018
arxiv:1606.04085, doi:10.1007/s00037-018-0164-8
6. K. Bringmann, C. Ikenmeyer and J. Zuiddam, *On algebraic branching programs of small width*, Journal of the ACM, 2018
arxiv:1702.05328, doi:10.1145/3209663
7. M. Christandl, P. Vrana and J. Zuiddam, *Asymptotic tensor rank of graph tensors: beyond matrix multiplication*, Computational complexity, 2018
arxiv:1609.07476, doi:10.1145/3209663

8. M. Bläser, M. Christandl and J. Zuiddam, *The border support rank of two-by-two matrix multiplication is seven*, Chicago Journal of Theoretical Computer Science, 2018
arxiv:1705.09652, doi:10.4086/cjtcs.2018.005
9. J. Zuiddam, *The asymptotic spectrum of graphs and the Shannon capacity*, Combinatorica, 2019
arxiv:1807.00169, doi:10.1007/s00493-019-3992-5
10. S. Arunachalam, P. Vrana and J. Zuiddam, *The asymptotic induced matching number of hypergraphs: balanced binary strings*, Electronic Journal of Combinatorics, 2020
arxiv:1905.03148, doi:10.37236/9019
11. M. Christandl, P. Vrana and J. Zuiddam, *Barriers for fast matrix multiplication from irreversibility*, Theory of Computing, 2020
arxiv:1812.06952
12. Y. Li and J. Zuiddam, *Quantum asymptotic spectra of graphs and non-commutative graphs, and quantum Shannon capacities*, IEEE Transactions on Information Theory, 2021
arxiv:1810.00744, doi:10.1109/TIT.2020.3032686
13. M. Christandl, F. Gesmundo, M. Michałek, J. Zuiddam, *Border rank non-additivity for higher order tensors*, SIAM Journal on Matrix Analysis and Applications
arxiv:2007.05458, doi.org/10.1137/20M1357366
14. M. Christandl, P. Vrana and J. Zuiddam, *Universal points in the asymptotic spectrum of tensors*, Journal of the AMS, 2021
arxiv:1709.07851, doi:10.1090/jams/996
15. S. Kopparty, G. Moshkovitz and J. Zuiddam, *Geometric rank of tensors and subrank of matrix multiplication*, Discrete Analysis, to appear
arxiv:2002.09472

6.3. Refereed conference proceedings

The full version of items 17, 18 and 19 appeared in a journal.

16. H. Buhrman, M. Christandl and J. Zuiddam, *Nondeterministic quantum communication complexity: the cyclic equality game and iterated matrix multiplication*, Proceedings of Innovations in Theoretical Computer Science Conference (ITCS), 2017
arxiv:1603.03757, doi:10.4230/LIPIcs.ITCS.2017.24
17. K. Bringmann, C. Ikenmeyer and J. Zuiddam, *On algebraic branching programs of small width*, Proceedings of Computational Complexity Conference (CCC), 2017
doi:10.4230/LIPIcs.CCC.2017.20
18. M. Christandl, P. Vrana and J. Zuiddam, *Universal points in the asymptotic spectrum of tensors*, Proceedings of the 50th Annual ACM SIGACT Symposium on Theory of Computing (STOC), 2018

arxiv:1709.07851, doi:10.1145/3188745.3188766

Invited to submit a full version of the paper to the journal Theory of Computing

19. M. Christandl, P. Vrana and J. Zuiddam, *Barriers for fast matrix multiplication from irreversibility*, Proceedings of Computational Complexity Conference (CCC), 2019
arxiv:1812.06952, doi:10.4230/LIPIcs.CCC.2019.26
Invited to submit a full version of the paper to the journal Theory of Computing
20. S. Kopparty, G. Moshkovitz and J. Zuiddam, *Geometric rank of tensors and subrank of matrix multiplication*. Proceedings of Computational Complexity Conference (CCC), 2020
arxiv:2002.09472, doi:10.4230/LIPIcs.CCC.2020.35
21. R. Robere and J. Zuiddam, *Amortized Circuit Complexity, Formal Complexity Measures, and Catalytic Algorithms*, Proceedings of 62nd Annual IEEE Symposium on Foundations of Computer Science (FOCS), 2021
eccc:2021/035, doi:10.1109/FOCS52979.2021.00079
22. M. Christandl, O. Fawzi, H. Ta and J. Zuiddam, *Larger Corner-Free Sets from Combinatorial Degenerations*, Proceedings of Innovations in theoretical computer science (ITCS), 2022
arxiv:2111.08262
23. H. Derksen, V. Makam and J. Zuiddam, *Subrank and Optimal Reduction of Scalar Multiplications to Generic Tensors*, Proceedings of Computational Complexity Conference (CCC), 2022
arxiv:2205.15168, doi:10.4230/LIPIcs.CCC.2022.9

6.4. Manuscripts in submission to a scientific journal

24. M. Christandl, F. Le Gall, V. Lysikov and J. Zuiddam, *Barriers for rectangular matrix multiplication*, Computational complexity
arxiv:2003.03019
25. M. Christandl, V. Lysikov and J. Zuiddam, *Weighted slice rank and a minimax correspondence to Strassen's spectra*
arxiv:2012.14412

6.5. Manuscripts

26. M. Christandl, O. Fawzi, H. Ta and J. Zuiddam, *Symmetric Subrank of Tensors and Applications*
arxiv:2104:01130
27. A. Wigderson and J. Zuiddam, *Asymptotic spectra: Theory, applications and extensions*
<https://staff.fnwi.uva.nl/j.zuiddam/papers/convexity.pdf>
28. M. Christandl, F. Gesmundo and J. Zuiddam, *A Gap in the Subrank of Tensors*

7. Scientific conferences organized

November–December 2022. Symmetries: Algebras and Physics – A thematic program in the Summer/Fall 2022, Centre de Recherches Mathématiques, co-organizer.

8. Scientific talks

8.1. Talks in refereed conferences

- Jul 2022 Computational Complexity Conference (CCC), Philadelphia, 2022
Talk: Subrank and Optimal Reduction of Scalar Multiplications to Generic Tensors
- Feb 2022 Symposium on Foundations of Computer Science (FOCS 2021), Denver, 2022
Talk: Amortized Circuit Complexity, Formal Complexity Measures, and Catalytic Algorithms
- Feb 2022 Innovations in Theoretical Computer Science (ITCS), Berkeley, 2022
Talk: Larger Corner-Free Sets from Combinatorial Degenerations
- July 2020 Computational Complexity Conference (CCC), Saarbrücken, 2020
Talk: Geometric rank of tensors and subrank of matrix multiplication
- July 2019 Computational Complexity Conference (CCC), New Brunswick, 2019
Talk: Barriers for fast matrix multiplication from irreversibility
- Jun 2018 Symposium on the Theory of Computing (STOC), Los Angeles, 2018
Talk: Universal points in the asymptotic spectrum of tensors
- Jan 2018 Conference on Quantum Information Processing (QIP), Delft, 2018
Talk: Universal points in the asymptotic spectrum of tensors
- July 2017 Computational complexity conference (CCC), Riga, 2017
Talk: On algebraic branching programs of small width
- Jan 2017 Innovations in theoretical computer science (ITCS), Berkeley, 2017
Talk: Nondeterministic quantum communication complexity

8.2. Invited talks

- Aug 2022 Workshop Semidefinite & Polynomial Optimization, Centrum Wiskunde & Informatica, Amsterdam
Talk: Shannon capacity via Real Algebraic Geometry and Strassen’s Positivstellensatz
- Apr 2022 Abel Prize Laureates Lectures, Centrum Wiskunde & Informatica, Amsterdam
- Mar 2022 Workshop on Random Tensors, Centre International de Rencontres Mathématiques (CIRM), Luminy, Marseille, France
- Nov 2021 Oberwolfach, Complexity Theory workshop
Talk: Asymptotic spectra: Theory, applications and extensions

- Sep 2021 Applied Algebra Seminar, UW Madison
Talk: Geometric rank of tensors and applications
- May 2021 Workshop on Efficient Tensor Representations for Learning and Computational Complexity, Institute for Pure & Applied Mathematics, UCLA
Talk: Subrank, slice rank and partition rank
- May 2021 Spring 2021 Virtual Meeting of the AMS Western Section
Talk: Subrank, slice rank and partition rank
- Mar 2021 Computer science and discrete math seminar, Institute for Advanced Study
Talk: Amortized Circuit Complexity, Formal Complexity Measures, and Catalytic Algorithms
- Jan 2021 UCSD Theory seminar
Talk: Tensor tools for problems in Combinatorics and Complexity
- Dec 2020 2020 Junior Theorists Workshop, Northwestern University, Chicago
Talk: Tensor Tools for Problems in Combinatorics and Complexity
- Oct 2020 Centrum Wiskunde & Informatica, From Euclidean to Geodesic Convex Optimization online reading group, Amsterdam
Talk: Extremal Combinatorics, Tensor scaling, Moment Polytopes
- Aug 2020 Mathematics Department, Texas A&M University
Talk: Combinatorics, Tensors and Geometry
- Jun 2020 Chennai Mathematical Institute, seminar on Recent Connections to GCT and Progress in GCT
Talk: Geometric Rank of Tensors
- May 2020 Centrum Wiskunde & Informatica, Amsterdam
Talk: Geometric Rank of Tensors
- Jan 2020 Department of Mathematics, University of Copenhagen
Talk: The asymptotic spectrum of tensors and barriers for fast matrix multiplication
- Oct 2019 Rutgers/DIMACS Theory of Computing Seminar
Talk: The asymptotic spectrum of tensors and barriers for fast matrix multiplication
- Oct 2019 Simons Collaboration on Algorithms & Geometry, New York City
Talk: The asymptotic spectrum of tensors and barriers for fast matrix multiplication
- May 2019 NYU Theoretical computer science seminar
Talk: The asymptotic spectrum of graphs: duality for Shannon capacity
- May 2019 Lorentz center Leiden, Mathematics of quantum information theory workshop
Talk: Asymptotic spectra
- April 2019 Rutgers discrete mathematics seminar
Talk: The asymptotic spectrum of graphs: duality for Shannon capacity

- March 2019 Princeton discrete mathematics seminar
Talk: The asymptotic spectrum of graphs: duality for Shannon capacity
- Nov 2018 Oberwolfach, Complexity Theory workshop, special session on matrix multiplication
Talk: Asymptotic spectra
- Jul 2018 Facets of complexity, Technische Universität Berlin
Talk: Asymptotic spectra of tensors and graphs: matrix multiplication exponent and Shannon capacity
- Apr 2018 Dutch Mathematical Congress, Royal Dutch Mathematical Society
Talk: The asymptotic spectrum of tensors
- Jan 2017 Stanford Institute for Theoretical Physics Seminar, Stanford University
Talk: On the tensor rank of graph tensors
- Nov 2016 Department of Mathematics, QMATH conference, University of Copenhagen
Talk: On the tensor rank of graph tensors
- Oct 2016 Algorithms and complexity seminar, Max-Planck-Institut für Informatik, Saarbrücken
Talk: On the tensor rank of graph tensors
- Jan 2015 Department of Mathematics, University of Copenhagen
Talk: Finding large gaps between tensor rank and border rank via algebras

8.3. Departmental talks

- Oct 2021 General Mathematics Colloquium, Korteweg-de Vries Institute for Mathematics, University of Amsterdam
Talk: Asymptotic spectra and applications
- Sep 2019 Computer science and discrete math seminar, Institute for Advanced Study
Talk: The asymptotic spectrum of graphs
Talk: Asymptotic spectra and applications
- Sep 2018 Computer science and discrete math seminar, Institute for Advanced Study
Talk: The asymptotic spectrum of tensors
Talk: Asymptotic spectra and applications
- June 2018 Algorithms and Complexity group seminar, Centrum Wiskunde & Informatica
Talk: The asymptotic spectrum of tensors

9. Student supervision

- 2022 Jim Wittebol, University of Amsterdam, MSc Thesis.
- 2022 Emiel Wiedijk, University of Amsterdam, co-advised with Chris Schaffner, BSc Thesis.
- 2017 – 2018 Pjotr Buys, University of Amsterdam, co-advised with Guus Regts.
MSc Thesis: *Asymptotic combinatorial subrank: applications and computations*

2016 – 2017 Jana Wagemaker, University of Amsterdam, co-advised with Harry Buhrman.
BSc Research project: *Close to clean communication complexity*

10. Teaching

Linear algebra, Amsterdam University College, University of Amsterdam, lecturer, 2022

Sets, numbers, proofs (Verzamelingen en Getallen), University of Amsterdam, lecturer, 2021, 2022

Computational Complexity, University of Amsterdam, teaching assistant and co-lecturer with Harry Buhrman, 2015. <http://complexity.buhrman.nl/2015/index.html>

Computer algebra and LaTeX, University of Amsterdam, teaching assistant and co-lecturer with Chris Zaal, 2012, 2013, 2014. <http://uva-fnwi.github.io/LaTeX/>

Algorithms and complexity, University of Amsterdam, teaching assistant and co-lecturer with Leen Torenvliet, 2014

11. Refereeing

11.1. Academic funding agencies

Israel Science Foundation

11.2. Scientific journals

Communications in Mathematical Physics, Linear and Multilinear Algebra, Theory of Computing, Discrete Mathematics, SIAM Review (SIREV), Computational Complexity, Journal of the ACM, Algebra & Number Theory, Indagationes Mathematicae, SIAM Journal on Applied Algebra and Geometry (SIAGA)

11.3. Scientific conferences

Conference on the Theory of Quantum Computation, Communication and Cryptography (TQC), International Colloquium on Automata, Languages and Programming (ICALP), Quantum Information Processing (QIP), Computational Complexity Conference (CCC), Foundations of Computer Science (FOCS), Innovations in Theoretical Computer Science (ITCS), IEEE International Symposium on Information Theory (ISIT), International Symposium on Mathematical Foundations of Computer Science (MFCS)

12. Departmental service

Member of the committee for the preparation of the government accreditation of the mathematics programmes, University of Amsterdam, 2012–2013

Member of the Editorial Board of *Amsterdam Science*, University of Amsterdam, 2015

Organizer of the General Mathematics Colloquium of the Korteweg-de Vries Institute for Mathematics, 2021–2022

13. References

Avi Wigderson
Institute for Advanced Study
School of Mathematics
1 Einstein Drive, Princeton, NJ 08540, USA
Email: avi@ias.edu

Noga Alon
Princeton University
Department of Mathematics
Princeton, NJ 08540, USA
Email: nalon@math.princeton.edu

Matthias Christandl
University of Copenhagen
Department of Mathematical Sciences
Universitetsparken 5, 2100 Copenhagen Ø, Denmark
Email: christandl@math.ku.dk

Peter Bürgisser
Technische Universität Berlin
Institut für Mathematik
Straße des 17. Juni 136, 10623 Berlin, Germany
Email: pbuerg@math.tu-berlin.de

Harry Buhrman
University of Amsterdam
Korteweg-de Vries Institute for Mathematics
Science Park 123, 1098 XG Amsterdam, Netherlands
Email: buhrman@cwi.nl