Jeroen Zuiddam

Curriculum vitae

September 5, 2023

1. Personal information

University of Amsterdam
Korteweg–de Vries Institute for Mathematics
University of Amsterdam
Science Park 107
1098 XG Amsterdam
The Netherlands

CWI
Room L213
Centrum Wiskunde & Informatica
Science Park 123
1098 XG Amsterdam
The Netherlands

`https://staff.fnwi.uva.nl/j.zuiddam/`
j.zuiddam@uva.nl

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

Nov. 2022 CRM–Simons Professor, Centre de recherches mathématiques (CRM), Montreal, Quebec, Canada

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

2023 NWO ENW M-1 Grant (€333.737 ≈ $363.174), Dutch Research Council NWO

2022 NWO EINF Grant for Computing Time on the National Computer Facilities, Dutch Research Council NWO

2022 CRM–Simons Professorship at the Centre de Recherches Mathématiques, Simons Foundation, November 2022

2021 NWO Veni Grant (€280.000 ≈ $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* arxiv:2212.01668

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

Mar 2023 University of Copenhagen, Denmark
Talk: Subrank of tensors

Mar 2023 Workshop on Algebraic Complexity Theory, University of Warwick, UK
Talk: Subrank of tensors

Feb 2023 Tel Aviv University, Israel
Talk: The subrank of a random tensor

Sep 2022	Kickoff workshop, Simons Semester on Algebraic Geometry with Applications to TEnsors and Secants, Warsaw University, Poland Talk: The subrank of random tensors
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

2023 Maxim van den Berg, University of Amsterdam, MSc Thesis.

2023 Jelle Sipkes, University of Amsterdam, coadvised with Nic Resch, BSc Thesis.

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, 2015. `http://complexity.buhrman.nl/2015/index.html`

Computer algebra and Latex, University of Amsterdam, teaching assistant and co-lecturer, 2012, 2013, 2014. `http://uva-fnwi.github.io/LaTeX/`

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

11. Refereeing

11.1. Academic funding agencies

Israel Science Foundation, European Research Council (ERC)

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), ACM-SIAM Symposium on Discrete Algorithms (SODA), Symposium on Theoretical Aspects of Computer Science (STACS)

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, 2021–2023

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