

Paul Breiding | Curriculum Vitae

✉ breiding@mis.mpg.de

🌐 personal-homepages.mis.mpg.de/breiding/, github.com/PBrdng
born 12th of May 1988 in Witzenhausen, Germany, german citizenship

Education

Max-Planck-Institute for Mathematics in the Sciences Leipzig

Postdoc in the nonlinear algebra research group

Since 10/2017

Area of research: Numerical algebraic geometry, relation between algebra and data science.

Simons Institute for the Theory of Computing

Visiting Graduate Student

08/2014 – 10/2014

Algorithms and Complexity in Algebraic Geometry

Technische Universität Berlin

PhD student with Prof. Dr. Bürgisser, overall evaluation 'summa cum laude'.

12/2013 – 09/2017

Area of research: Numerical and statistical aspects of tensor-rank decomposition.

Georg-August-Universität Göttingen

Master of Science, Grade: 1,1, overall evaluation 'excellent'.

10/2011 – 11/2013

Universidad de Sevilla

Undergraduate studies, part of the Erasmus exchange program

02/2011 – 09/2011

Georg-August Universität Göttingen

Bachelor of Science, Grade: Sehr Gut (1,5)

10/2008 – 09/2011

Otto-Hahn-Gymnasium Göttingen

Abitur, Grade: Sehr Gut (1,4)

06/2007

Languages.....

German: *fluent, native*

English: *fluent*

Publications

Journal articles.....

- [1] P. Breiding. The expected number of eigenvalues of a real gaussian tensor. *SIAM J. Appl. Algebra Geometry*, 1(1), 254–271 (2017).
- [2] P. Breiding and P. Bürgisser. Distribution of the eigenvalues of a random system of homogeneous polynomials. *Linear Algebra and its Applications*, Vol. 497, p.88–107 (2016).
- [3] P. Breiding, K. Kozhasov, and A. Lerario. On the geometry of the set of symmetric matrices with repeated eigenvalues. *Arnold Math J.*, 2019.
- [4] P. Breiding, B. Sturmfels, S. Kalisnik Verovsek, and M. Weinstein. Learning algebraic varieties from samples. *Revista Matemática Complutense* 31 545–593 (2018).
- [5] P. Breiding and N. Vannieuwenhoven. The condition number of join decompositions. *SIAM J. Matrix Anal. and Appl.*, 39(1), 287–309 (2018).
- [6] P. Breiding and N. Vannieuwenhoven. Convergence analysis of Riemannian Gauss-Newton methods and its connection with the geometric condition number. *Applied Mathematics Letters*, 78, pp. 42–50 (2018).
- [7] P. Breiding and N. Vannieuwenhoven. A Riemannian trust region method for the canonical tensor rank approximation problem. *SIAM J. Optim.* 28-3 (2018), pp. 2435–2465. Source code for the MATLAB implementation available at <https://arxiv.org/src/1709.00033v2/anc>.

Software projects.....

- [8] P. Breiding and S. Timme. Homotopycontinuation.jl: A package for homotopy continuation in julia. Website: juliahomotopycontinuation.org. GitHub: github.com/JuliaHomotopyContinuation. Published in: Mathematical Software – ICMS 2018. Lecture Notes in Computer Science.

- Blog posts.....
- [9] P. Breiding and S. Timme. juliahomotopycontinuation.org/blog/. An ongoing series of blog posts on solving problems by using Numerical Algebraic Geometry.
- Preprints.....
- [10] C. Beltrán, P. Breiding, and N. Vannieuwenhoven. Pencil-based algorithms for tensor rank decomposition are not stable. *arXiv1807.04159*.
- [11] P. Breiding. The average number of critical rank-one-approximations to a symmetric tensor. *arXiv1701.07312*.
- [12] P. Breiding. An efficient randomized homotopy method to approximate eigenpairs of tensors. *arXiv1512.03284*.
- [13] P. Breiding, K. Kozhasov, and A. Lerario. Random spectrahedra. *arXiv1711.08253*.
- [14] P. Breiding and O. Marigliano. Sampling from the uniform distribution on an algebraic manifold. *arXiv1810.06271*.
- [15] P. Breiding and N. Vannieuwenhoven. On the average condition number of tensor rank decompositions. *arXiv1801.01673*.
- Theses.....
- [16] P. Breiding. Zyklotomische Körper und die Fermat–Gleichung zum Exponent p^2 ., 2011. Grade: 1.0. First supervisor: Preda Mihailescu. Second supervisor: Maarten Solleveld.
- [17] P. Breiding. On a p-adic newton method. Master’s thesis, Georg-August Universität Göttingen, 2013. Grade: 1.0. First supervisor: Preda Mihailescu. Second supervisor: Peter Bürgisser.
- [18] P. Breiding. *Numerical and Statistical Aspects of Tensor Decompositions*. PhD thesis, TU Berlin, 2017. First supervisor: Peter Bürgisser. Second supervisor: Felipe Cucker.

Teaching experience

Lecture: Condition – the geometry of numerical algorithms <i>Max-Planck Institute for Mathematics in the Sciences</i>	Lecturer 10/2018–01/2019
Math for teenage refugees <i>Stiftung SPI Berlin</i>	Teacher 03/2016–11/2016
Algebra, Analysis, Linear algebra, Multivariate Polynomials <i>TU Berlin</i>	Teaching Assistant 12/2013 – 09/2017
Statistics for medical students <i>Institut für medizinische Statistik, UMG Göttingen</i>	Tutor 06/2013 – 09/2013
Linear Algebra 1 & 2, Microeconomics 1 & 2 <i>Georg-August-Universität Göttingen</i>	Tutor 10/2010 – 03/2013

Organizational experience

Minisymposium on Random Geometry and Topology <i>SIAM Conference on Applied Algebraic Geometry</i>	Organizer 07/2019
Minisymposium on Numerical Methods in Algebraic Geometry <i>SIAM Conference on Applied Algebraic Geometry</i>	Organizer 07/2019
Summer School on Randomness and Learning in Nonlinear Algebra <i>Max-Planck Institute for Mathematics in the Sciences</i>	Organizer 07/2019
Workshop on Random Algebraic Geometry <i>SISSA</i>	Organizer 11/2018
Max-Planck Day <i>Munich</i> Presentation of MPI MiS to a general audience	Organizer 09/2018
Summer School on Numerical Computing in Algebraic Geometry <i>Max-Planck Institute for Mathematics in the Sciences</i>	Organizer 08/2018
Berlin-Leipzig Seminar on Algebra, Geometry and Combinatorics <i>Max-Planck Institute for Mathematics in the Sciences/TU Berlin/FU Berlin</i>	Organizer 10/2017 – 12/2017

Peer reviewing

for the following journals: SIAM Journal on Applied Algebra and Geometry, Linear Algebra and its Applications, Journal Foundations of Computational Mathematics, Proceedings of the Royal Society A.

Invited talks

Low-Rank Optimization and Applications

Max-Planck Institute for Mathematics in the Sciences 04/2019

Complexity Reduction in Algebraic Statistics

OvGU Magdeburg 11/2018

Workshop on Random Real Geometry

SISSA 10/2018

Seminar za Numeričku Matematiku i Znan. Računanje

University of Zagreb 10/2018

International Symposium on Mathematical Programming (ISMP)

University of Bordeaux 07/2018

Numerical Methods for Curves

University of Rennes 02/2018

9th polymake conference and developer meeting

TU Berlin 02/2018

Seminar Numerische Lineare Algebra

University of Osnabrück 01/2018

Open Source Computer Algebra Research (OSCAR)

Max-Planck Institute for Mathematics in the Sciences 12/2017

2nd Algebraic Statistics Day

Max-Planck Institute for Mathematics in the Sciences 11/2017

Algebra meets Numerics: Condition and Complexity

TU Berlin 11/2017

SIAM Conference on Applied Algebraic Geometry

Georgia Tech, Atlanta. 07/2017

Minisymposium on Random Algebraic Geometry

Reading Group on Real Algebraic Geometry

Max-Planck Institute for Mathematics in the Sciences 07/2017

Foundations of Computational Mathematics Conference

University of Barcelona 07/2017

"What is ...?" seminar

TU Berlin 07/2017

Live recording available at vimeo.com/256622174

Tensors: Algebra meets Numerics

Max-Planck Institute for Mathematics in the Sciences 12/2016

Algorithms and Complexity in Algebraic Geometry reunion meeting

Simons Institute for the Theory of Computing, Berkeley 12/2015