

Alexander Taveira Blomenhofer

Curriculum Vitae

Education

- 2022 **Dr. rer. nat. in Mathematics**, *Universität Konstanz, summa cum laude*,
Doctoral thesis:
“Gaussian mixture separation and denoising on parameterized varieties”.
Advisors: Prof. Dr. Markus Schweighofer and Prof. Dr. Mateusz Michałek
- 2018 **M. Sc. Mathematics**, *Universität Konstanz*, 1.0.
Master’s thesis: “A new algorithm for overcomplete tensor decomposition based on sums-of-squares optimisation” supervised by Prof. Dr. Markus Schweighofer.
- 2016 **B. Sc. Mathematics**, *Universität Konstanz*, 1.0.
Bachelor’s thesis: “Erweiterte Formulierungen für Polygone” (Extended formulations for polygons, 2016) supervised by Prof. Dr. Markus Schweighofer.
- 2013 **Abitur (high school graduation)**, *Droste-Hülshoff-Gymnasium Meersburg*.

Employment

- July 2024 - * **Postdoctoral Researcher at QMATH centre**, supported by the ERC grant of Matthias Christandl, University of Copenhagen.
- Jan 2023 - **Postdoctoral Researcher at CWI in Amsterdam**, supported by the OPTIMAL grant, with Monique Laurent.
- June 2024
- 2018-2022 **Research Assistant**, *Dep. Mathematics and Statistics, Universität Konstanz, Konstanz*.

Teaching

- Winter 2025 **Commutative Algebra**, joint teaching with Nidhi Kaihnsa, University of Copenhagen.
- Spring 2024 **Mastermath course on Semidefinite Optimization**, with Monique Laurent and Fernando de Oliveira Filho, VU Amsterdam.
- 2022/23-WT **TA: Linear Algebra I**, Univ. Konstanz.
- 2022-ST **TA: Linear Algebra II**, Univ. Konstanz.
- 2021/22-WT **TA: Linear Algebra I**, Univ. Konstanz.
- 2021/22-WT **TA: Geometry of Linear Matrix Inequalities**, Univ. Konstanz.
- 2021-ST **TA: Real Algebraic Geometry II**, Univ. Konstanz.

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- 2021-ST **Advanced Data and Information Literacy Track (ADILT)** course “**Vectors, Matrices and Tensors for Data Analysis with Julia**”, with Markus Schweighofer, Univ. Konstanz.
- 2020/21-WT **TA: Real Algebraic Geometry I**, Univ. Konstanz.
- 2020/21-WT **TA: Algorithmic Spectral Graph Theory**, Univ. Konstanz.
- 2020-ST **TA: Commutative Algebra**, Univ. Konstanz.
- 2019/20-WT **TA: Algorithmic Algebraic Geometry**, Univ. Konstanz.
- 2019-ST **TA: Polynomial Optimization**, Univ. Konstanz.
- 2019-ST **TA: Number Theory**, Univ. Konstanz.
- 2018/19-WT **TA: Introduction to Algebra**, Univ. Konstanz.

Organization

- 2023-2024 **Networks & Optimization Seminar**, biweekly seminar at CWI, with Sander Borst, Hilde Verbeek and Danish Kashaev, CWI, Amsterdam.
- 2020-ST **Seminar on Real Geometry and Algebra**, w. Markus Schweighofer, Uni Konstanz.
- 2019/20-WT **Seminar on Real Geometry and Algebra**, w. Markus Schweighofer, Uni Konstanz.

Supervision

- 2018-2024 **Co-supervision**, of various bachelor and masters students of Markus Schweighofer, Universität Konstanz.

Publications

- 2022 **Identifiability for Mixtures of Centered Gaussians and Sums of Powers of Quadratics**, with Alex Casarotti, Mateusz Michałek and Alessandro Oneto.
In: Bulletin of L.M.S., id: BLMS12871
- 2021 **Ideals of Spaces of Degenerate Matrices**, with Mateusz Michałek und Julian Vill.
In: Linear Algebra and Its Applications (LAA-D-21-00505R1),
[sciencedirect.com/science/article/abs/pii/S0024379522001677](https://www.sciencedirect.com/science/article/abs/pii/S0024379522001677)

Preprints

- 2023 **Nondefectivity of invariant secant varieties**, with Alex Casarotti.
arXiv:2312.12335
- 2023 **Gaussian mixture identifiability from degree 6 moments**
To appear in: Algebraic Statistics
arXiv:2307.03850
- 2023 **Unique powers-of-forms decompositions from simple Gram spectrahedra**
To appear in: SIAGA
arXiv:2305.06860

Extended stays

- Oct 2024 **Research Stay**, CWI, Amsterdam.
I am received by Monique Laurent at CWI for two weeks to work on a project on quantum de Finetti theorems.

Nov 2023 **Research Stay**, *Università di Trento*.

I was received by Alessandro Oneto at the university of Trento for a week to present and discuss a partial solution of the Baur-Draisma-de Graaf conjecture.

Talks, posters, conferences and other venues

July 2024 **MEGA 2024**, *MPI-MiS*, Leipzig.

Poster: *Dimensions of invariant secant varieties*.

April 2024 **Dutch Mathematical Congress**, *TU Delft*.

Invited talk for AIM: *Algebraic Geometry in Machine Learning*.

March 2024 **MoPAT24**, *Universität Konstanz*, Conference on polynomial and tensor optimization.

Invited talk: *Nondefectivity of invariant secant varieties*

Oct 2023 **Chow Lectures**, *MPI-MiS*, Leipzig.

Sep 2023 **Conference on Applied Algebra**, *Universität Osnabrück*.

Poster: *Identifiability of Gaussian mixtures from sixth-order moments*.

Jul 2023 **SIAM AG**, *TU Eindhoven*, Eindhoven.

Invited minisymposium talk: *Unique powers-of-forms decompositions from simple Gram spectrahedra*.

Jun 2023 **FOCM**, *Sorbonne Université*, Paris.

Poster in the Data Science and Machine Learning session (II.4):

Identifiability of Gaussian mixtures from sixth-order moments.

May 2023 **OPTIMAL meeting**, *TU Delft*, Delft.

Talk: *Unique power sum decompositions from simple Gram spectrahedra*.

April 2023 **DIAMANT symposium**, *De Zalen van Zeven*, Utrecht.

Talk: *Identifiability of Gaussian Mixtures from their sixth moments*

April 2023 **Dutch Mathematical Congress**, *Van der Walk Hotel*, Utrecht.

Mar 2023 **Real Algebraic Geometry with a View toward Koopman Operator Methods**, *Mathematisches Forschungsinstitut Oberwolfach*, Oberwolfach.

Talk: *A semidefinite algorithm for powers-of-forms decomposition*.

2022 **Workshop on Semidefinite and Polynomial Optimization**, *CWI*, Amsterdam.

2022 **International Conference on Continuous Optimization (ICCOPT)**, *Lehigh University*, Bethlehem, PA, USA.

Invited minisymposium talk: *Projecting towards the image set of a polynomial map with Sum-of-Squares Relaxations*.

2022 **MEGA 2022**, *Pedagogical University of Kraków*, Kraków, Poland.

Talk: *Identifiability for Mixtures of Gaussians* (joint work with A. Casarotti, M. Michałek and A. Oneto).

2020 **Real Algebraic Geometry with a View Toward Hyperbolic Programming and Free Probability**, *Mathematisches Forschungsinstitut Oberwolfach*, Oberwolfach.

2019 **SIAM Conference on Applied Algebraic Geometry**, *Universität Bern*, Bern.

2019 **Arctic Applied Algebra**, *University of Tromsø*, Tromsø.

Talk on the topic of my master's thesis.

- 2018 **International Conference on Polynomial and Tensor Optimization**, *Xiangtan University*, Xiangtan (Hunan Province, PR China).
Talk on the topic of my master's thesis.
- 2018 **Summer School on Numerical Computing in Algebraic Geometry**, *Max Planck Institute for Mathematics in the Sciences*, Leipzig.

Services

- 2019-* **Reviewer for zbMath.**
2024-* **Peer reviewing for SIAGA.**

Miscellaneous

- 2021–2022 **Corona-News-Portal Regensburg.**
I wrote an automatic thematic news classifier for a regional Covid news portal, based on samples classified by volunteers.
- 2016–2018 **∃-Quest.**
Indie video game project built with PixiJs.

Programming Skills

- Routined JULIA, particularly JuMP, MultivariatePolynomials, SumOfSquares and generally multilinear algebra and sum-of-squares optimization. Also DataFrames, LIBSVM etc. and partial experience with symbolic computation (OSCAR, NEMO...)
- Intermediate PYTHON, JavaScript, L^AT_EX, Bash/Shell, Jupyter
- Basic C, Java

Languages

- Native **German**
Fluent **English, Portuguese, Dutch**
Basic **French, Danish**

Research Interests

- Secant Varieties
- Computational Complexity
- Machine Learning
- Computational Algebraic Geometry
- Invariant Theory
- Algebraic Statistics
- Quantum Information Theory
- Semidefinite Programming

References

Matthias Christandl, *Professor, Department of Mathematical Sciences, University of Copenhagen*, Phone: +45 3533 2298, E-mail: christandl@math.ku.dk.

Monique Laurent, *Scientific Staff Member, CWI, Amsterdam and Professor at Universiteit Tilburg*, Phone: +31 20 592 4105, E-mail: M.Laurent@cwi.nl.

Markus Schweighofer, Professor, Department of Mathematics and Statistics, Universität Konstanz, Phone: +49 7531 88 2579, E-mail: markus.schweighofer@uni-konstanz.de.

Mateusz Michałek, Professor, Department of Mathematics and Statistics, Universität Konstanz, E-mail: mateusz.michalek@uni-konstanz.de.

Alessandro Oneto, Associate Professor, Department of Mathematics, Università di Trento, E-mail: alessandro.oneto@unitn.it.

Pravesh Kothari, Assistant Professor, Department of Computer Science, Princeton University and School of Math, IAS, E-mail: kotpravesh@gmail.com, kothari@cs.princeton.edu.