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 - June 2026 **Postdoctoral Researcher at QMATH centre**, *supported by the ERC Grant of Matthias Christandl*, University of Copenhagen.

Jan 2023 - June 2024 **Postdoctoral Researcher supported by the OPTIMAL grant**, *CWI*, Amsterdam, with Monique Laurent.

2018-2022 **Research Assistant**, *Dep. Mathematics and Statistics, Universität Konstanz*, Konstanz.

Teaching

2024/25 **Commutative Algebra**, *joint with Nidhi Kaihnsa*, University of Copenhagen.

Spring 2024 **Mastermath course on Semidefinite Optimization**, *with Monique Laurent and Fernando de Oliveira Filho*, Univ. Konstanz.

2019-2022 **(Co-)Supervision of various bachelor's and master's theses**.

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.

QMATH centre, Lyngbyvej 2, 4th floor – 2100 Copenhagen
✉ *atb@math.ku.dk* • *a44l.github.io* • *Date of birth: 17.05.1995*

2021-ST **TA: Vectors, Matrices and Tensors for Data Analysis with Julia**, Advanced Data and Information Literacy Track (ADILT), 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.

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`

Preprints

2023 **Nondefectivity of invariant secant varieties**, with Alex Casarotti.
arXiv:2312.12335

2023 **Gaussian mixture identifiability from degree 6 moments**
arXiv:2307.03850

2023 **Unique powers-of-forms decompositions from simple Gram spectrahedra**
arXiv:2305.06860

Talks, posters, conferences and other venues

Upcoming

July 2024 **MEGA 2024**, *MPI-MiS*, Leipzig.
Poster: *Dimensions of invariant secant varieties.*

Past

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

Nov 2023 **Research Stay**, *Università di Trento*.
I was glad to be received by Alessandro Oneto at the university of Trento for a week.

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 Forschungsinsitut 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**.

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, LaTeX, 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.