

Personal information

Name Dr. Tobias Andreas Boege
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Date of birth December 7, 1994

Education and Work Experience

- Sep 2022 – Sep 2023** Postdoc in the Applied non-linear algebra group of Kaie Kubjas at Aalto University, Espoo.
- Oct 2021 – Sep 2022** Postdoc in the Non-linear Algebra group of Bernd Sturmfels at the Max-Planck Institute for Mathematics in the Sciences, Leipzig.
- Oct 2018 – Oct 2021** PhD studies at OvGU Magdeburg within the research training group “Mathematical complexity reduction” (MathCoRe).
Thesis title: The Gaussian conditional independence inference problem;
advisors: Thomas Kahle and Volker Kaibel.
Defense on 22 April 2022 with total predicate **summa cum laude**.
Awarded “Best doctoral dissertation” of the University of Magdeburg.
- Oct 2016 – Oct 2018** Master of science in Mathematics with honors at OvGU Magdeburg,
with secondary subject Computer science.
Thesis title: Construction methods for gaussoids; advisor: Thomas Kahle.
Awarded “Best M.Sc. graduate” of the Mathematics department.
- Oct 2013 – Nov 2016** Bachelor of science in Mathematics with honors at OvGU Magdeburg,
with secondary subject Computer science.
Thesis title: On permutations with decidable cycles; advisor: Thomas Kahle.
Awarded “Best B.Sc. graduate” of the Mathematics department.

Research

Research interests. My research interest are fundamental laws and limits in algebraic statistics, information theory and computational geometry. I am particularly interested in conditional independence structures and matroids, their representability by probability distributions or geometric configurations. These questions are generally hard in the sense of algorithmic and algebraic complexity. To overcome these difficulties in practice, I devise algorithms for proving and certifying representability and non-representability.

Publications.

- Tobias Boege. “The Gaussian conditional independence inference problem”. PhD thesis. OvGU Magdeburg, 2022. DOI: <https://doi.org/10.25673/86275>.
- Tobias Boege. “Selfadhesivity in Gaussian conditional independence structures”. In: *Proceedings of the 12th Workshop on Uncertainty Processing*. Ed. by Milan Studený, Nihat Ay, Giulianella Coletti, Gernot D. Kleitner, and Prakash P. Shenoy. 2022, pp. 25–36.
- Tobias Boege. *No eleventh conditional Ingleton inequality*. 2022. arXiv: [2204.03971 \[cs.IT\]](https://arxiv.org/abs/2204.03971).
- Tobias Boege, Sonja Petrović, and Bernd Sturmfels. “Marginal Independence Models”. In: *Proceedings of the 2022 International Symposium on Symbolic and Algebraic Computation*. ISSAC ’22. Villeneuve-d’Ascq, France: Association for Computing Machinery (ACM), 2022, pp. 263–271. DOI: [10.1145/3476446.3536193](https://doi.org/10.1145/3476446.3536193).

- Tobias Boege, Thomas Kahle, Andreas Kretschmer, and Frank Röttger. “The geometry of Gaussian double Markovian distributions”. In: *Scandinavian Journal of Statistics* (2022). DOI: <https://doi.org/10.1111/sjos.12604>.
- Tobias Boege. *Incidence geometry in the projective plane via almost-principal minors of symmetric matrices*. 2021. arXiv: [2103.02589](https://arxiv.org/abs/2103.02589) [math.ST].
- Tobias Boege. “Gaussoids are two-antecedental approximations of Gaussian conditional independence structures”. In: *Ann. Math. Artif. Intell.* 90 (2022), pp. 645–673. DOI: [10.1007/s10472-021-09780-0](https://doi.org/10.1007/s10472-021-09780-0).
- Tobias Boege, Jane Ivy Coons, Christopher Eur, Aida Maraj, and Frank Röttger. “Reciprocal Maximum Likelihood Degrees of Brownian Motion Tree Models”. In: *Le Matematiche* 76.2 (2021), pp. 383–398. DOI: [10.4418/2021.76.2.6](https://doi.org/10.4418/2021.76.2.6).
- Tobias Boege and Thomas Kahle. “Construction Methods for Gaussoids”. In: *Kybernetika* 56.6 (2020), pp. 1045–1062. DOI: [10.14736/kyb-2020-6-1045](https://doi.org/10.14736/kyb-2020-6-1045).
- Tobias Boege, Alessio D’Alì, Thomas Kahle, and Bernd Sturmfels. “The Geometry of Gaussoids”. In: *Found. Comput. Math.* 19.4 (2019), pp. 775–812. DOI: [10.1007/s10208-018-9396-x](https://doi.org/10.1007/s10208-018-9396-x).
- Tobias Boege. *On permutations with decidable cycles*. B.Sc. thesis. 2016. arXiv: [1612.05136](https://arxiv.org/abs/1612.05136) [math.LO].

Talks given at conferences.

- Workshop on Algorithmic aspects of information theory, July 2022, Schloss Dagstuhl: “Universality of Gaussian conditional independence models”.
- 47th International Symposium on Symbolic and Algebraic Computation (ISSAC), July 2022, Lille: “Marginal independence models”.
- Annual meeting of the IMS, June 2022, London: “Gaussian conditional independence beyond graphical models”.
- 12th Workshop on Uncertainty Processing, June 2022, Kutná Hora: “Selfadhesivity in Gaussian conditional independence structures”.
- Tagung der Fachgruppe Computeralgebra, March 2022, München: “The laws of Gaussian conditional independence”.
- Mini-symposium on Decision Making Theory, September 2021, Prague: “The Gaussian conditional independence inference problem”.
- Prague Stochastics Workshop in Memory of František Matúš, August 2019, Prague: “On discrete representability of Gaussian CI models (from the perspective of the identity matrix)”.

Participation in conferences and workshops.

- European Women in Mathematics General Meeting, August 2022, Aalto University, Espoo.
- Workshop on Algebraic Geometry, Combinatorics, and Machine Learning, July 2022, MPI-MiS Leipzig.
- Workshop on Algorithmic aspects of information theory, July 2022, Schloss Dagstuhl.
- 47th International Symposium on Symbolic and Algebraic Computation (ISSAC), July 2022, Lille.
- Annual meeting of the Institute of Mathematical Statistics (IMS), June 2022, London.
- Conference on the Mathematics of Complex Data, June 2022, KTH Stockholm.
- Arctic MSCA Symposium with Cordian Riener, June 2022, UiT Tromsø.
- 14th Nordic Combinatorial Conference (NORCOM), June 2022, UiT Tromsø.
- 12th Workshop on Uncertainty processing (WUPES), June 2022, Kutná Hora.
- Combinatorial cowork space on Algebraic and geometric combinatorics, March 2022, Kleinwalsertal.
- Tagung der Fachgruppe Computeralgebra, March 2022, München.
- MaRDI kickoff workshop, November 2021, MPI-MiS Leipzig.
- Research stay at UTIA Prague with Milan Studený, 12–18 September 2021.
- SIAM conference on Applied Algebraic Geometry, August 2021, Texas A&M.
- Mini-course on Convex Geometry, July 2021, MPI-MiS Leipzig.
- Compact course Algebra of tensors, April 2021, MathCoRe Magdeburg.
- Compact course Polynomial optimization, August 2020, MathCoRe Magdeburg.
- Working group on Linear spaces of symmetric matrices, June–July 2020, MPI-MiS Leipzig.
- Spring school Mathematical Statistics, April 2020, MPI-MiS Leipzig, *cancelled*.
- Algebraic Structures in Statistical Methodology workshop, March 2020, Oberwolfach, *cancelled*.
- Graphical Models workshop, October 2019, München.
- SIAM Conference on Applied Algebraic Geometry, July 2019, Bern.
- Workshop on Applied Algebra, June 2019, Braunschweig.

- Summer school Invitation to Non-linear Algebra, June 2019, MPI-MiS Leipzig.
- Graduate Student Meeting in Applied Algebra and Combinatorics, February 2019, Leipzig.
- MPI-INF and MPI-MiS joint workshop on Theoretical Computer Science and Algebraic Geometry, January 2019, Saarbrücken.
- Macaulay2 Workshop, June 2018, MPI-MiS Leipzig.
- Foundations of Mathematics: Univalent foundations and set theory, July 2016, ZIF Bielefeld.

Teaching

- Winter 2020: taught and organized 5-day intensive preparation course for incoming economics students “Vorkurs Fit für die Finanzmathematik und Statistik”.
- Winter 2019: substitute tutor for “Lineare Algebra I”.
- Winter 2015 – Summer 2017: tutor for “Lineare Algebra I und II”.
- Winter 2015: tutor for “Grundlagen der Theoretischen Informatik I”.

Service

- Co-editor of the Dagstuhl seminar report 22301 on “Algorithmic aspects of information theory” contributing an extensive list of open problems gathered from the participants in informal discussions, talks and the dedicated open problem sessions.
- Co-organizer of the “Leipzig–Magdeburg seminar day” at MPI-MiS Leipzig, together with Thomas Kahle.
- Tutorial on “Mathematical Software: How to get started” at MPI-MiS Leipzig, together with Ronald Kriemann and Javier Sendra.
- Organizing the Non-linear algebra seminar at MPI-MiS Leipzig in the summer term 2022 with Alessandro Neri.
- Graduate Student Meeting in Applied Algebra and Combinatorics, April 2021, Copenhagen. Jointly organized with Angelica Torres, Beatriz Escudero and Benjamin Smith (initially planned for April 2020).
- Supervision of Garrett Cunningham (Ohio Univ.) in RISE Germany internship “Formal conditional independence structures”, June – August 2020.
- December 2020 – October 2021, organization of the weekly MathCoRe fellow seminar and website.
- Referee for *Electronic Journal of Statistics*, *International Mathematics Research Notices* and *SODA* conference. Reviewer for zbMATH.

Skills

- Languages: German (native), English (fluent).
- Successful participation in “Presentations skills” course by the German National Institute for Science Communication (NaWik).
- Programming languages: Perl, Macaulay2, Julia (proficient), Mathematica, C99, C++11 (experienced), Polymake, sagemath (acquainted).
- Experience in problem modeling and solving using SAT (#SAT, AllSAT) solvers, linear programming and discrete geometry (`soplex`, `normaliz`).