Dominik Stöger

CONTACT INFORMATION

KU Eichstätt-Ingolstadt
Department of Mathematics and Geograpy
Mathematical Institute for Machine Learning and Data Science (MIDS)
Auf der Schanz 49, 85049 Ingolstadt, Germany

Email: Dominik.Stoeger@ku.de
Web: dominiksto.github.io

RESEARCH INTERESTS

- Mathematics of Data Science
- Non-convex optimization in signal processing and machine learning
- Overparameterized models in machine learning models
- Stability and robustness of convex approaches for low-rank matrix recovery problems
- High-dimensional probability and statistics

CURRENT ACADEMIC EMPLOYMENT

KU Eichstätt-Ingolstadt, Eichstätt, Germany
Assistant professor for Data Science (Tenure Track), September 2021 – present
Department of Mathematics and Geography

PAST ACADEMIC EMPLOYMENT

University of Southern California, Los Angeles, CA
Postdoctoral Research Scholar, September 2019 – August 2021
Ming Hsieh Department of Electrical and Computer Engineering
Mentor: Prof. Mahdi Soltanolkotabi

EDUCATION

Technical University of Munich, Munich, Germany

Ph.D., Mathematics, January 2016 – August 2019

- Thesis Topic: *Bilinear Compressed Sensing*
- Grade: *summa cum laude* (with highest distinction)
- Adviser: Prof. Felix Krahmer

M.Sc., Mathematics, October 2013 – December 2015

- Thesis Topic: *Perimeter inequality under spherical symmetrization: Equality cases*
- Adviser: Prof. Marco Cicalese, Dr. Filippo Cagnetti

B.Sc., Mathematics, May 2011 – October 2013

- Thesis Topic: *Applications of topological methods to PDEs of variational type*
- Adviser: Prof. Marco Cicalese, Dr. Francesco Solombrino

HONORS AND AWARDS

- Dr.-Klaus-Körper Prize of GAMM (2020)
  given annually to four awardees "in appreciation for an excellent dissertation in Applied Mathematics and Mechanics"

OFFERS FOR PROFESSORSHIP POSITIONS

- Tenure-Track Professorship *Mathematical Methods for Data Science*, University of Vienna, February 2023 (Offer Declined)
- Tenure-Track Professorship *Data Science*, KU Eichstätt-Ingolstadt, December 2021

PUBLICATIONS

I publish both in mathematics journals and in machine learning (ML) conferences. Since in ML the main conferences are the primary venues of publication, below no distinction is made between math journals and ML conferences.
Authors are listed in alphabetical order in all articles except [8, 9] and the (electrical engineering) conference proceedings [17, 19, 21].

* Preprints:

[1] P. Geuchen, T. Heindl, D. **Stöger**, and F. Voigtlaender. *Upper and lower bounds for the Lipschitz constant of random neural networks*. 2023. arXiv: 2311.01356.

[2] H.-H. Chou, J. Maly, and D. **Stöger**. *How to induce regularization in generalized linear models: A guide to reparametrizing gradient flow*. 2023. arXiv: 2308.04921.

[3] J. Kostin, F. Krahmer, and D. **Stöger**. *How robust is randomized blind deconvolution via nuclear norm minimization against adversarial noise?* 2023. arXiv: 2303.10030.

* Refereed journal articles and machine learning conference proceedings:

[4] M. Soltanolkotabi, D. **Stöger**, and C. Xie. "Implicit Balancing and Regularization: Generalization and Convergence Guarantees for Overparameterized Asymmetric Matrix Sensing". In: *Proceedings of Thirty Sixth Conference on Learning Theory (COLT)*, pp. 5140–5142. URL: https://proceedings.mlr.press/v195/soltanolkotabi23a.html.

[5] A. Ma, D. **Stöger**, and Y. Zhu. "Robust recovery of low-rank matrices and low-tubal-rank tensors from noisy sketches". English. In: *SIAM J. Matrix Anal. Appl.* 44.4 (2023), pp. 1566–1588. ISSN: 0895-4798. DOI: 10.1137/22M150071X.

[6] K. Lee and D. **Stöger**. "Randomly Initialized Alternating Least Squares: Fast Convergence for Matrix Sensing". In: *SIAM Journal on Mathematics of Data Science* 5.3 (2023), pp. 774–799. DOI: 10.1137/22M1506456. eprint: https://doi.org/10.1137/22M1506456. URL: https://doi.org/10.1137/22M1506456.

[7] C. Kümmerle, C. Mayrink Verdun, and D. **Stöger**. "Iteratively reweighted least squares for basis pursuit with global linear convergence rate". In: *Advances in Neural Information Processing Systems* ***(Spotlight paper, top 3% of submissions)*** 34 (2021), pp. 2873–2886.

[8] D. **Stöger** and M. Soltanolkotabi. "Small random initialization is akin to spectral learning: Optimization and generalization guarantees for overparameterized low-rank matrix reconstruction". In: *Advances in Neural Information Processing Systems* 34 (2021), pp. 23831–23843.

[9] Y. Balaji, M. Sajedi, N. Kalibhat, M. Ding, D. **Stöger**, M. Soltanolkotabi, and S. Feizi. "Understanding Over-parameterization in Generative Adversarial Networks". In: *International Conference on Learning Representations (ICLR)*. 2021.

[10] F. Krahmer and D. **Stöger**. "On the convex geometry of blind deconvolution and matrix completion". English. In: *Commun. Pure Appl. Math.* 74.4 (2021), pp. 790–832. ISSN: 0010-3640; 1097-0312/e. URL: https://onlinelibrary.wiley.com/doi/abs/10.1002/cpa.21957.

[11] F. Krahmer and D. **Stöger**. "Complex phase retrieval from subgaussian measurements". In: *J. Fourier Anal. Appl.* 26.6 (2020), pp. 1–27. URL: https://link.springer.com/article/10.1007/s00041-020-09797-9.

[12] F. Cagnetti, M. Perugini, and D. **Stöger**. "Rigidity for perimeter inequality under spherical symmetrisation". In: *Calc. Var. Partial Differential Equations* 59.4 (2020), pp. 1–53. URL: https://link.springer.com/article/10.1007%2Fs00526-020-01786-6.

[13] J. Geppert, F. Krahmer, and D. **Stöger**. "Sparse power factorization: balancing peakiness and sample complexity." English. In: *Adv. Comput. Math.* 45.3 (2019), pp. 1711–1728. ISSN: 1019-7168; 1572-9044/e. URL: https://link.springer.com/article/10.1007/s10444-019-09698-6.

[14] P. Jung, F. Krahmer, and D. **Stöger**. "Blind demixing and deconvolution at near-optimal rate." English. In: *IEEE Trans. Inf. Theory* 64.2 (2018), pp. 704–727. ISSN: 0018-9448. URL: https://ieeexplore.ieee.org/document/8240933.

* Book chapters:

[15] T. Fuchs, D. Gross, P. Jung, F. Krahmer, R. Kueng, and D. **Stöger**. "Proof methods for robust low-rank matrix recovery". English. In: *Compressed sensing in information processing*. Cham: Birkhäuser, 2022, pp. 37–75. ISBN: 978-3-031-09744-7; 978-3-031-09745-4. DOI: 10.1007/978-3-031-09745-4_2.

* Conference proceedings:

[16] F. Krahmer and D. **Stöger**. "Blind deconvolution: Convex geometry and noise robustness". In: *52nd Annual Asilomar Conference on Signals, Systems, and Computers*. IEEE. 2018. URL: https://ieeexplore.ieee.org/document/8645337.

[17] D. **Stöger**, J. Geppert, and F. Krahmer. "Sparse power factorization with refined peakiness conditions". In: *2018 IEEE Statistical Signal Processing Workshop (SSP)*. IEEE. 2018, pp. 816–820. URL: https://ieeexplore.ieee.org/document/8450850.

[18] J. A. Geppert, F. Krahmer, and D. **Stöger**. "Refined performance guarantees for Sparse Power Factorization". In: *12th International Conference on Sampling Theory and Applications (SampTA)*. IEEE. 2017, pp. 509–513. URL: https://ieeexplore.ieee.org/document/8024391.

[19] D. **Stöger**, P. Jung, and F. Krahmer. "Blind demixing and deconvolution with noisy data at near optimal rate". In: *Wavelets and Sparsity XVII*. Vol. 10394. International Society for Optics and Photonics. 2017, 103941E. URL: https://www.spiedigitallibrary.org/conference-proceedings-of-spie/10394/2271571/Blind-demixing-and-deconvolution-with-noisy-data-at-near-optimal/10.1117/12.2271571.short?SSO=1.

[20] P. Jung, F. Krahmer, and D. **Stöger**. "Blind Demixing and Deconvolution with Noisy Data: Near-optimal Rate". In: *21st International ITG Workshop on Smart Antenna*. 2017. URL: https://ieeexplore.ieee.org/document/7955979.

[21] D. **Stöger**, P. Jung, and F. Krahmer. "Blind deconvolution and compressed sensing". In: *2016 4th International Workshop on Compressed Sensing Theory and its Applications to Radar, Sonar and Remote Sensing (CoSeRa)*. IEEE. 2016, pp. 24–27. URL: https://ieeexplore.ieee.org/document/7745692.

PRESENTATIONS **Talks at Conferences and Workshops:**

- Oberwolfach Workshop on Applied Harmonic Analysis and Data Science, Oberwolfach, April 2024
- GAMM Annual Meeting, Magdeburg, March 2024
- LMCRC Workshop on Mathematical Information Science, Lagrange Research Center, Paris, October 2023

- Section on "Mathematics of Data Science" at the DMV Meeting 2023, Ilmenau, September 2023
- Minisymposium on "Low-Rank Models in Data Science" at ICIAM 2023, Tokyo, August 2023 *(Talk given virtually)*
- 8th International Conference on Computational Harmonic Analysis (ICCHA 2022)
- Oberwolfach Workshop on Applied Harmonic Analysis and Data Science, Oberwolfach, November 2021
- ICCOPT 2019 (International Conference on Continuous Optimization), Berlin, August 2019
- Applied Inverse Problems, Grenoble, France, July 2019
- Asilomar Conference on Signals, Systems and Computers, Monterey, California, October 2018
- SIAM Conference on Imaging Science, Bologna, Italy, June 2018
- Wavelets and Sparsity, San Diego, USA, August 2018
- Workshop Donau-Isar-Inn: Approximation Theory and Applications, University of Innsbruck, Austria, March 2017
- CoSeRa 2016 (International Workshop on Compressed Sensing Theory and its Applications to Radar, Sonar, and Remote Sensing), RWTH Aachen, Germany, September 2016
- The First Colloquium on the Priority Programme "Compressed Sensing in Information Processing", RWTH Aachen, Germany, July 2016

Seminar talks:

- Department of Mathematics, University of Munich, Munich, May 2024
- MIDS Seminar, KU Eichstätt-Ingolstadt, October 2022
- KU-LMU-TUM Joint Seminar on Mathematics of Data Science (virtual), November 2021
- Department of Mathematics, RWTH Aachen, Aachen, Germany, September 2021
- Department of Mathematics, Catholic University of Eichstätt-Ingolstadt, Eichstätt, Germany, May 2021
- Department of Mathematics, University of California, San Diego, USA, February 2020
- Department of Mathematics, Catholic University of Eichstätt-Ingolstadt, Eichstätt, Germany, January 2019
- Department of Electrical and Computer Engineering, Ohio State University, Columbus, USA, November 2018
- Center for Information and Signal Processing, Georgia Institute of Technology, Atlanta, USA, August 2017

Poster presentations:

- Winter School on Modern Methods in Nonsmooth Optimization, University of Würzburg, Germany, March 2018
- 3rd International Matheon Conference on Compressed Sensing and its Applications, TU Berlin, Germany, December 2017
- International BASP Frontiers workshop, Villars-sur-Ollon, Switzerland, February 2017

ADVISING AND MENTORING

(Co-)Mentoring of Ph.D. students:

- **Changzhi Xie**, Ph.D. student, January 2020 – August 2021
  (with Prof. Mahdi Soltanolkotabi)
  Topic: *Implicit regularization in overparameterized learning problems*

B.Sc. and M.Sc. theses:

- **Konstantin Schernstein**, Summer 2019, M.Sc. Thesis
  (with Prof. Felix Krahmer)
  Thesis topic: *On the Stability of Principal Component Pursuit*
- **Anna Heinrich**, Summer 2017, B.Sc. Thesis
  (with Prof. Felix Krahmer)
  Thesis topic: *A comparison of two algorithms for the phase retrieval problem*

TEACHING EXPERIENCE

KU Eichstätt-Ingolstadt, Eichstätt/Ingolstadt, Germany

- Probability Theory (Summer semester 2024, lecture and exercises)
- Foundations of Data Science (Winter Semester 2023/2024, lecture)
- More data, more insights? Modern data science methods from a transdisciplinary perspective (Winter Semester 2023/2024, joint lecture with 7 other professors, university-wide teaching initiative on Foundations of Data Science)
- Introduction to Linear Programming (Summer semester 2023, lecture and exercise classes)
- Topics in Data Science (Winter semester 2022/2023, lecture and exercises classes)
- Introduction to Linear Programming (Summer semester 2022, lecture and exercise classes)
- Introduction to Data Science (Winter semester 2021/2022, lecture and exercise classes)

Technical University of Munich, Munich, Germany

Organization of exercise sessions:

- Probabilistic Methods and Algorithms in Data Analysis (Winter 2016/2017)
  (organized jointly with Christian Kümmerle)

Teaching Assistant:

- Foundations in Statistics (Summer 2018)
- Probabilistic Methods and Algorithms in Data Analysis (Winter 2016/2017)
- Vector Analysis (Winter 2015/2016)

Organization of seminars for Bachelor and Master students:

- A Master Class on Inequalities (Summer 2017)
  (Student seminar on elementary inequalities following the book "The Cauchy-Schwarz Master Class" by Michael Steele, organization jointly with Prof. Felix Krahmer)
- Approximation Methods (Winter 2016/2017)
  (organization jointly with Prof. Felix Krahmer)

ORGANIZATION OF RESEARCH SEMINARS

Technical University of Munich, Munich, Germany

- Reading seminar on *High Dimensional Data Analysis* (Winter 2017–Summer 2019)
  (organized jointly with Dr. Sara Krause-Solberg, Christian Kümmerle, and Johannes Maly)
- *Mathematics of Data Analysis* (Winter 2016/2017– Winter 2017/2018)
  (Research seminar, organized jointly with Prof. Massimo Fornasier and Prof. Felix Krahmer)

PROFESSIONAL SERVICE

Organization of sessions and minisymposia in conferences:

- Section on "Mathematics of Data Science" at the DMV Meeting 2023 (joint with Prof. Felix Voigtlaender), Ilmenau, Germany
- Minisymposium on "Low-Rank Models in Data Science" at ICIAM 2023 (joint with Prof. Christian Kümmerle and Prof. Johannes Maly), Tokyo, Japan
- Special session on "Methods for Low-Rank Matrices and Tensors" at SampTA 2023 (joint with Prof. Anna Ma), New Haven, USA

Organization of conferences:

- (Co-)Organizer of the "8th International Conference on Computational Harmonic Analysis" (ICCHA 2022), Ingolstadt, Germany

Reviewer for science organizations:

- *German Federal Ministry of Education and Research (BMBF)*

Reviewer for the following journals:

- *Analysis and Applications*
- *Applied and Computational Harmonic Analysis*
- *Annals of Statistics*
- *Constructive Approximation*
- *Foundations of Computational Mathematics*
- *IEEE Transactions on Information Theory*
- *IEEE Transactions on Neural Networks and Learning Systems*
- *IEEE Transactions on Signal Processing*
- *IEEE Wireless Communication Letters*
- *Information and Inference*
- *Information Processing Letters*
- *Journal of Fourier Analysis and Applications*
- *Journal of Imaging*
- *Journal of Mathematical Imaging and Vision*
- *Linear Algebra and its Applications*
- *Quantum*
- *SIAM Journal on Imaging Sciences (SIIMS)*
- *SIAM Journal on Matrix Analysis and Applications (SIMAX)*

Reviewer for the following conferences:

- *Thirty-sixth Conference on Neural Information Processing Systems (NeurIPS 2022)*
- *Thirty-fifth Conference on Neural Information Processing Systems (NeurIPS 2021)*
- *Thirty-fourth Conference on Neural Information Processing Systems (NeurIPS 2020)*
- *Conference on Learning Theory (COLT 2024)*
- *Conference on Learning Theory (COLT 2023)*
- *Conference on Learning Theory (COLT 2022)*
- *Conference on Learning Theory (COLT 2021)*
- *International Conference on Machine Learning (ICML 2021)*
- *International Conference on Learning Representations 2022 (ICLR 2023)*
- *International Conference on Learning Representations 2022 (ICLR 2022)*
- *International Conference on Learning Representations 2021 (ICLR 2021)*
- *International Conference on Learning Representations 2020 (ICLR 2020)*
- *2022 IEEE International Symposium on Information Theory (ISIT)*
- *2020 IEEE International Symposium on Information Theory (ISIT)*
- *13th International Conference on Sampling Theory and Applications 2023*
- *13th International Conference on Sampling Theory and Applications 2019*
- *12th International Conference on Sampling Theory and Applications 2017*

Service at KU Eichstätt-Ingolstadt:

- Member of the team that was responsible for creating the new BSc program in "Data Science" at KU Eichstätt-Ingolstadt
- Founding member of the Mathematical Institute for Machine Learning and Data Science
- Member of the Examination Board for the BSc Data Science at KU (since September 2022)

Outreach activities:

- Panel discussion on "Robots in our everyday lives - is AI conquering our lives?", November 2021 (transfer.talk at KU)
- Panel discussion on "Bringing digitalization into line with humanity" (see this news article)