

Johannes Krotz

Curriculum Vitae

Education

- 2024 **PhD in Mathematics**, *Minor in Computational Sciences*, University of Tennessee Knoxville, GPA – 4.0.
Dissertation: *Probabilistic and data-driven methods in numerical PDE*
- 2024 **Master of Science in Statistics**, *University of Tennessee*, Knoxville, GPA – 4.0.
- 2021 **Master of Science in Mathematics**, *Oregon State University*, GPA – 4.0.
- 2019 **Master of Science in Physics**, *University of Konstanz*, GPA – 4.0, with honors: 'excellent'.
Thesis: *Computer simulations of gel formation in colloidal systems of sticky rods*
- 2018 **Bachelor of Science in Mathematics**, *University of Konstanz*, GPA – 3.7.
Thesis: *Gibt es rotationssymmetrische Fische: Existence proof for fish-shaped networks evolving under Gaussian curvature flow*
- 2015 **Bachelor of Science in Physics**, *University of Konstanz*, GPA – 3.5.
Thesis: *Quantum transport in topological insulator-superconductor heterostructures conducted at Reykjavik University, Reykjavik, Iceland*
- 2012 **Abitur (higher education entrance qualification)**, *Friedrich-Woehler Gymnasium*, Singen, GPA – 3.7.

Grants and Awards

- 2024 Third place UTK SIAM research showcase
- 2023 First place UTK SIAM research showcase
- 2023 Academic Excellence Fellowship (UTK Math)
- 2023 Graduate Student Senate Travel Awards
- 2022 Randall E. Cline Awards
- 2022 National Science Foundation Mathematical Sciences Graduate Internship (NSF MSGI)
- 2022 Academic Excellence Fellowship (UTK Math)
- 2021 F. M. Dryzer Memorial Graduate Fellowship
- 2021 National Science Foundation Mathematical Sciences Graduate Internship (NSF MSGI)
- 2021 Oregon State Continued Success Scholarship for Internationals (could not accept)
- 2020 PNNL-OSU Distinguished Graduate Research Program (could not accept full duration)

- 2020 National Science Foundation Mathematical Sciences Graduate Internship (NSF MSGI)
- 2018 Second place in LöPhi awards for excellent teaching (awarded through the physics student union according to student vote)

Research/Work experience

- 2024 Postdoctoral Researcher at University of Notre Dame Department of Aerospace and Mechanical Engineering. Research and development of hybrid Monte Carlo/Deterministic kinetic transport algorithms in collaboration with the Center for Exascale Monte Carlo Neutron Transport
- 2023 **GRA funded through ORNL** Advancement of dynamic likelihood filters to stochastic advection-diffusion equations with Juan Restrepo and Jorge Ramirez
- 2022 **Research Intern at ORNL - Mathematics In Computation funded through NSF MSGI** Development of hybrid algorithms for the numerical simulation of complex particle systems in 2D & 3D with Cory Hauck and Ryan McClarren
- 2021 **Research Intern at ORNL - Mathematics In Computation funded through NSF MSGI** Development of hybrid algorithms for the numerical simulation of complex particle systems in 1D with Cory Hauck and Ryan McClarren
- 2020 **Research Intern at LANL - Computational Earth Science funded through NSF MSGI** Advancing High-Fidelity Discrete Fracture Networks: Development and implementation of fast maximal 2D- and 3D -Poisson-disk sampling algorithms for high quality triangulations of discrete fracture networks with Carl Gable, Jeffrey Hyman and Matthew Sweeney
- 2019 **Master student in AG Nielaba - Statistical and Computational Physics(Konstanz)** Computer simulations of colloidal systems, anisotropic particles, exploration of emerging patterns and gel formation through clustering, TDA, analysis of shear stress and more
- 2018 **Bachelor student in AG Schnuerer - Differential Geometry** Work on the existence of solutions to Gaussian and mean curvature flows under symmetry restraints
- 2015 **Exchange scholar at Reykjavik University & Bachelor student in AG Belzig - Quantum Transport** Theoretical exploration of topics around topological insulators and superconductivity with Erlingsson Sigurður Ingi

Publications

1. *Scatter-Limited Hybrid Monte Carlo, Deterministic Transport with Quasi-Monte Carlo Sampling*, **Johannes Krotz**, Ryan McClarren submitted to PHYSOR 2026
2. *Curvilinear coordinates and curvature in radiative transport*, **Johannes Krotz**, Ryan McClarren under review in Journal of computational and theoretical transport, 2025
3. *A dynamic likelihood approach to filtering transport processes: advection-diffusion dynamics*, **Johannes Krotz**, Juan M. Restrepo, Jorge Ramirez, Journal of Computational Physics, Volume 536, 2025, <https://doi.org/10.1016/j.jcp.2025.114089>
4. *A Hybrid Monte Carlo, Discontinuous Galerkin method for linear kinetic transport equations*, **Johannes Krotz**, Cory D. Hauck, Ryan G. McClarren, Journal of Computational Physics, vol. 514, 2024, <https://doi.org/10.1016/j.jcp.2024.113253>.
5. *Variable resolution Poisson-disk sampling for meshing discrete fracture networks*, **Johannes Krotz**, Matthew R. Sweeney, Jeffrey D. Hyman, Juan M. Restrepo, Carl W. Gable, Journal of Computational and Applied Mathematics vol. 407 <https://doi.org/10.1016/j.cam.2022.114094>

Conferences and Workshops

Invited talks

- 2025 *Normalizing Flow-Based Monte Carlo Transport Simulation*, presented at International Conference on Monte Carlo Methods and Applications (MCM2025), Chicago
- 2025 *Hybrid Monte Carlo methods for kinetic transport*, presented at International Conference on Monte Carlo Methods and Applications (MCM2025), Chicago
- 2025 *MCDG for MCDC - Hybrid Monte Carlo Discontinuous Galerkin Methods for Exascale Transport* presented at 2025 PSAAP III Final Review Meetings, Raleigh NC
- 2025 *Minimizing Uncertainty in Transport Problems through Dynamic Likelihood Filtering* presented at Southeastern Atlantic Section of SIAM Section Meeting 2025, Knoxville
- 2025 *Minimizing Uncertainty in Transport Problems through Dynamic Likelihood Filtering* presented at 2025 AMS Spring Central Sectional Meeting, Lawrence
- 2025 *Introduction to Bayesian Filtering and applications in Transport problems* presented at Applied Math and Computation Seminar, Oregon State University
- 2024 *Hybrid method for kinetic transport equations*, presented at SIAM New York-New Jersey-Pennsylvania Section Conference, Rochester
- 2024 *A Hybrid Monte Carlo, Discontinuous Galerkin method for linear kinetic transport equations* presented at Center for Exascale Monte Carlo Neutron Transport
- 2024 *A Dynamic Likelihood approach to Filtering* presented at MAA-SE section meeting, Tennessee
- 2024 *Efficient solvers for kinetic transport equations* presented at University of Konstanz, Colloquium on Numerical Optimization

- 2023 *Efficient solvers for the neutron transport equation* presented at Karlsruher Institut für Technologie (KIT), Oberseminar (Comp. Science and Mathematical Methods)
- 2023 *A Hybrid Monte Carlo, Discontinuous Galerkin method for linear kinetic transport equations* presented at 6th annual SIAM Texas-Louisiana Sectional Meeting, Lafayette

Contributed talks(† Posters)

- 2025 † *Dynamic Likelihood Filtering - Data Assimilation for Advective Transport*, presented at Data Assimilation and Inverse Problems for Digital Twins (IMSI/Illinois Institute of Technology)
- 2025 † *Conditional Normalizing flows for Transport Simulation*, presented at Statistical and Computational Challenges in Probabilistic Scientific Machine Learning (SciML), Chicago
- 2025 † *Minimizing Uncertainty in Transport Problems through Dynamic Likelihood Filtering*, presented at Uncertainty Quantification and Machine Learning for Complex Physical Systems (IMSI/Illinois Institute of Technology)
- 2025 † *A Dynamic Likelihood approach to Filtering*, presented at 2025 PSAAP III Final Review Meetings, Raleigh NC
- 2024 † *A Dynamic Likelihood approach to Filtering*, presented at Robust Optimization and Simulation of Complex Stochastic System (ICERM/Brown)
- 2023 *A Hybrid Monte Carlo, Discontinuous Galerkin method for linear kinetic transport equations*, presented at Summer School on Computational & Data Science at Duke University
- 2023 † *A Hybrid Monte Carlo, Discontinuous Galerkin method for linear kinetic transport equations*, presented at The University of Chicago AI+Science Summer School
- 2022 † *Hybrid methods for the numerical simulation of complex particle systems*, presented at 2022 NSF MSGI Summer Research Symposium
- 2020 *Data set reduction in TDA with an example from soft matter physics*, presented at Data Science and Image Analysis Conference of the Pacific Northwest, Pullman(Washington)
- 2019 † *Gel formation in colloidal Systems of sticky rods*, SFB 1214: Anisotropic Particles as Building Blocks Konstanz(Germany)
- 2018 † *Computer Simulation of anisotropic colloidal particles*, Symposium on anisotropic particles, Konstanz(Germany)

Attended

- 2025 Uncertainty Quantification and Machine Learning for Complex Physical Systems, Institute for Mathematical and Statistical Innovation
- 2021 Gene Golub Siam Summer School: Theory and Practice of Deep Learning
- 2019 Geometric analysis and general relativity, ETH Zürich
- 2019 Geometric analysis meets geometric topology, Heidelberg(Germany)
- 2018 Progress and visions in quantum theory in view of gravity, Leipzig(Germany)
- 2018 Summer school in algebraic statistics, Tromsø(Norway)

2018 Winter school geometric evolution Equations, Konstanz(Germany)

Service

- 2025 CRC Press (Taylor & Francis Group) — Book Proposal Reviewer
- 2025 Reviewer for Journal of Sound and Vibration
- 2025 Reviewer for several papers in Journal of Computational and Theoretical Transport
- 2025 Guest Editor for Special Issue of Journal of Computational and Theoretical Transport
- 2025 Organizer Minisymposium on *Applications and Algorithms for Diff. Eq. in Modelling and Engineering* at Southeastern Atlantic Section of SIAM Section Meeting 2025
- 2025 Judge, Northern Indiana Regional Science and Engineering Fair
- 2023-2024 Elected member of UTK's Math Grad Student Council(MGSCI)
- 2021-2022 Elected member of UTK's Grad student senate
- 2010-2020 Elected board member Musikverein Bohlingen (Orchestra)
 - 2018-2020 **2nd Chairman**: Coordination and organization of concerts, fundraisers, festivals grossing up to ≈ 300000 \$,
 - 2013-2018 **Youth coordinator**: Coordinating youth orchestra, finding/hiring instrumental teachers and conductors, organizing merger and inclusion of 2 neighboring youth orchestras, organizing concerts and retreats

Professional Memberships

- Society for Industrial and Applied Mathematics(SIAM)
- American Mathematical Society (AMS)
- Association of Women in Mathematics(AWM)
- American Association for the Advancement of Science(AAAS)
- Society for the Advancement of Chicanos/Hispanics and Native Americans in Science (SACNAS)
- The honor society of $\Phi K \Phi$

Programming & Computational Skills

Scientific Computing:

- **Python** – Primary language for research. Developed simulation pipelines, hybrid Monte Carlo solvers, stochastic interpolants, and DNN models. Contributed to MCDC, a CUDA-compatible exascale neutron transport code using Numba. Created a mesh generation module now used in DFNWorks for porous media flow and PDEs.
- **C/C++** – Maintained and extended a large colloidal particle simulation package as part of MS thesis. Integrated OpenMP-based parallelism for HPC execution with moderate success. Frequently interfaced with Fortran in large-scale simulation frameworks.
- **Matlab** – Used for 2D radiation transport solvers combining MC and discrete ordinates. Implemented PDE solvers, uncertainty quantification algorithms (e.g., Kalman-type filters), and

completed coursework in Bayesian inference, optimization, and numerical analysis.

- **Fortran** – Read and interfaced with legacy Fortran code in LANL's DFNWorks. Used for small solvers and coursework.

Tooling and Environment:

- **High-Performance Computing:** Frequent use of HPC systems for running large-scale particle and PDE simulations.
- **Version Control & Shell:** Proficient in Git, Bash, and typical HPC workflows
- **LaTeX:** Over 10 years of experience, including Beamer and Tikz
- **Visualization:** Experienced with Matplotlib, Gnuplot, Matlab, and Python-based scientific plotting.
- **AI-assisted coding:** Regular use of tools like GitHub Copilot and LLMs (e.g., ChatGPT) to accelerate prototyping, refactoring, and debugging.

Languages

German **Native**

English **Fluent** *6+ years of academic work in the US; 115/120 on TOEFL in 2019*

Italian **Conversational** *5 years of instruction; functional with immersion*

Teaching

University of Tennessee Knoxville

Spring 2023 Instructor of Record for Finite Math (MTH 123)

Fall 2022 Instructor of Record for Finite Math (MTH 123)

Spring 2022 Instructor of Record for Basic Calculus (MTH 125)

Fall 2021 Basic Calculus (MTH 125)

Oregon State University

Spring 2021 Advanced Calculus II (MTH 312)

Winter 2021 Advanced Calculus II (MTH 311)

Fall 2020 Linear Algebra II (MTH 342)

Spring 2020 Linear Algebra I (MTH 341)

Winter 2020 College Algebra (MTH 111)

Fall 2019 Elementary Functions (MTH 112)

University of Konstanz

Summer 2019 Real Analysis II (Department of Mathematics)

Summer 2019 Linear Algebra and Analysis for Computer Scientists (Department of Computer and Information Science)

Winter 18/19 Theoretical Physics III (Department of Physics)

Winter 18/19 Mathematics for Physicists III (Department of Mathematics)

Summer 2018 Discrete Mathematics (Department of Computer and Information Science)

Summer 2018 Mathematics for Physicists II (Department of Mathematics)

Winter 17/18 Mathematics for Physicists III (Department of Mathematics)

Summer 2017 Mathematics for Physicists II (Department of Mathematics)
Winter 16/17 Mathematics for Physicists I (Department of Mathematics)
Summer 2016 Discrete Mathematics (Department of Computer and Information Science)