Katherine Henneberger

k.henneberger@uky.edu (304)-685-6339

Experience

Graduate Research Assistant *Lexington, KY*
University of Kentucky, Department of Mathematics *2022 - Present*

- Developed novel regularized Kaczmarz algorithms for high-order tensor recovery.
- Applied ℓ_1^p norm and log-sum regularization methods to image sequence destriping and color video deblurring, resulting in improved relative error results as compared to current methods.
- Designed and implemented tensor-based algorithms using CUR decomposition and 3D total variation, improving overall accuracy in hyperspectral band selection applications.
- Tools used: MATLAB, Python

Research Intern *Berlin, Germany*
JCMwave GmbH, Software Company *Summer 2024*

- Reduced FEM execution time by 50% through Bayesian optimization of hyperparameters for metasurface simulations.
- Developed a forward surrogate model using neural network ensembles and Gaussian processes to efficiently predict power fluxes, achieving a median absolute error of 3.5×10^{-4} per diffraction order.
- Implemented a tandem neural network architecture to solve inverse problems in optical metasurface design, enabling efficient reconstruction of dot-projector geometry for arbitrary power flux distributions.
- Utilized advanced machine learning techniques including an ensemble of 70 fully connected neural networks to enhance simulation accuracy and efficiency.
- Tools used: Python, JCMsolve

Graduate Teaching Assistant *Lexington, KY*
University of Kentucky, Department of Mathematics *2020 - Present*

- Coordinate academic support for 60 students per semester in mathematics through structured teaching roles across varied calculus levels.
- Served as Primary Instructor (Elementary Calculus, Calculus I), Lead Teaching Assistant (Finite Math), Teaching Assistant (Elementary Calculus, Calculus I, Calculus II, Calculus I for Biology, Calculus II for Biology), and Grader (Calculus IV).

Research Intern *Medford, MA*
MGGG Redistricting Lab at Tufts University *Summers 2019 and 2020*

- Engaged with topics in statistics, graph theory, networks, and topology as they relate to current research projects on political redistricting.
- Analyzed partisan effects of gerrymandering, using Markov Chain algorithms to create ensembles of districting plans based on census data and GIS shapefiles.
- Led a research project analyzing city demographics in districting plans using Topological Data Analysis
- Tools used: Python, ArcGIS

Education

University of Kentucky, Department of Mathematics *August 2020 - May 2025*
PhD degree, anticipated 2025
MS degree

- Dissertation: Regularized Methods for Tensor Recovery and Decomposition

Bowdoin College *August 2016 - May 2020*
AB degree

- Majors: Mathematics, Hispanic Studies
- Minors: Government and Legal Studies

Publications

- K. Henneberger, and J. Qin, "Power of ℓ_1-Norm Regularized Kaczmarz Algorithms for High-Order Tensor Recovery." arXiv preprint:2405.08275.
- K. Henneberger and J. Qin, "Hyperspectral Band Selection based on Generalized 3DTV and Tensor CUR Decomposition." Asilomar Conference on Signals, Systems and Computers, 2024 (to appear).
- K. Henneberger and J. Qin, "Log-Sum Regularized Kaczmarz Algorithms for High-Order Tensor Recovery." Association of Women in Mathematics Research Symposium, 2023 (to appear).
- K. Henneberger, L. Huang, and J. Qin, "Hyperspectral Band Selection Based on Matrix CUR Decomposition." In IGARSS 2023-2023 IEEE International Geoscience and Remote Sensing Symposium, pp. 7380-7383. IEEE, 2023.

Presentations and Workshops

Invited Talks

- **SIAM Conference on Computational Science and Engineering**, Fort Worth, TX, March 2025:
  "Log-Sum Regularized Kaczmarz Algorithms for High-Order Tensor Recovery"
- **Joint Mathematical Meetings**, Seattle, WA, January 2025:
  "Hyperspectral Band Selection Based on Generalized 3DTV and Tensor CUR Decomposition"
- **Asilomar Conference on Signals, Systems, and Computers**, Monterey, CA, October 2024:
  "Hyperspectral Band Selection based on Generalized 3DTV and Tensor CUR Decomposition"
- **SIAM Conference on Imaging Science**, Atlanta, GA, May 2024:
  "Log-Sum Regularized Kaczmarz Algorithms for High-Order Tensor Recovery"
- **American Institute of Mathematical Sciences Conference Series on Dynamical Systems and Differential Equations**, Wilmington, NC, May 2023:
  "Hyperspectral Band Selection with Matrix CUR Decomposition"

Workshops

- **JPMorgan Chase & Co. Quantitative Research Virtual Experience Program on Forage**, Virtual, November 2023: Workshop on quantitative research methods
- **SLMath Summer Graduate School on Mathematics of Big Data**, San Jose, CA, July 2023: Sketching and (Multi-)Linear Algebra workshop, hosted at IBM Almaden

Awards and Leadership

University of Kentucky Mathematics Department Fellowship Award *May 2024*

Awarded in recognition of outstanding research by a doctoral student.

Society for Industrial and Applied Mathematics *May 2022 – Present*
Chapter President

- Coordinate annual speaking engagements, fostering knowledge transfer from industry mathematicians to academic departments.
- Collaborate across 4 academic departments, enhancing applied mathematics research and development initiatives through partnership programs.

Association of Women in Mathematics *May 2021 – May 2024*
Chapter President

- Fostered an inclusive environment, impacting over 20 female students through mentorship and community initiatives.
- Organized 7 events to celebrate diversity in mathematics, enhancing community engagement and awareness.