

Matthew Kehoe

Data/Research Scientist

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Research Interests

- Applied mathematics and computational science
- Numerical analysis and partial differential equations
- Machine learning and natural language processing
- Acoustics and electromagnetics
- High performance computing
- Calculating zeros of the Riemann zeta function

Education

University of Illinois at Chicago <i>Ph.D. in Applied Mathematics</i> Advisor: Professor David Nicholls Thesis: Joint Analyticity of the Transformed Field and Dirichlet-Neumann Operator in Periodic Media	Chicago, IL 2018–2022
University of Michigan at Dearborn <i>M.S. in Computational Mathematics</i> Advisor: Professor Frank Massey MS Project: Computational methods for the Riemann zeta function	Dearborn, MI 2013–2015
University of Otago <i>Exchange student</i>	Dunedin, New Zealand 2010
Oakland University <i>B.A. in Economics, Minor in Computer Science</i>	Rochester, MI 2006–2010

Employment

Elder Research <i>Senior Data Scientist</i>	Arlington, VA 2025–Present
Michigan Tech Research Institute <i>Research Scientist</i>	Ann Arbor, MI 2022–2025
University of Illinois at Chicago <i>Graduate Research and Teaching Assistant</i>	Chicago, IL 2018 – 2022
Cold Regions Research and Engineering Laboratory <i>NSF Mathematical Sciences Graduate Internship</i>	Hanover, NH Summer 2020
Argonne National Laboratory <i>NSF Mathematical Sciences Graduate Internship</i>	Lemont, IL Summer 2019
Workforce Software <i>Software Consultant/Programmer</i>	Livonia, MI 2010–2017
Oakland University <i>Web Developer</i>	Rochester, MI 2009–2010

Publications

- 1: M. Kehoe and D. Nicholls, "A Stable High–Order Perturbation of Surfaces/Asymptotic Waveform Evaluation Method for the Numerical Solution of Grating Scattering Problems," *Journal of Scientific Computing* 100 (1), 9 (2024). [Manuscript](#).
- 2: M. Kehoe and D. P. Nicholls, "Joint Geometry/Frequency Analyticity of Fields Scattered by Periodic Layered Media," *SIAM Journal on Mathematical Analysis*, Volume 55, Issue 3, 1737–1765 (2023). [Manuscript](#).

Teaching Experience

University of Illinois at Chicago

Graduate TA: Lead recitation sessions and assisted students with coursework in

Chicago, IL

2018–2021

- Calculus 1 (4 semesters)
- Numerical Analysis (2 semesters)
- Differential Equations (1 semester)
- Mathematical Biology (1 semester)
- Precalculus (1 semester)

My student reviews are listed [here](#).

Mathematical Modeling Experience

Michigan Tech Research Institute

Computational Electromagnetics and Signal Processing

Research

2022–2025

- Developed algorithms to automate the identification of moving ground vehicles using synthetic aperture radar (SAR).
- Corrected geometric distortions and deformations at reflected energy point locations using affine transformations.
- Used the Pycharm IDE to build new programs to identify point locations from scattered energy.

University of Illinois at Chicago

High–Order Perturbation of Surfaces (HOPS)

Thesis

2019–2022

- Investigated the existence and uniqueness of solutions to a system of partial differential equations which model the interaction of linear waves with multilayered media.
- Implemented the HOPS algorithm to produce highly accurate, rapid, and robust numerical schemes.
- Proved joint analyticity of the transformed field with respect to two small physical parameters.
- Developed spectral element methods in the Matlab programming language.

Cold Regions Research and Engineering Laboratory

Mathematics Research Internship

Virtual Summer Internship

2020

- Wrote Fortran code in the Elmer finite element software for multiphysical problems.
- Compared competing models which predict thaw depths, frost heave, and thaw settlement in pavements.
- Collaborated with other researchers at CRREL and improved the accuracy of the thermodynamic model.

Argonne National Laboratory

Mathematics Research Internship

Summer Internship

2019

- Developed a parallel algorithm in C++ to replace existing Matlab code.
- Used the Radon transform and its inverse to test the parallel efficiency and speedup on the Beebop supercomputer at Argonne.
- Collaborated with other scientists at Argonne and presented my results at the summer student symposium.

University of Michigan at Dearborn

MS Project

Zeros of the Riemann Zeta Function

2015

- Wrote Java code to calculate millions of nontrivial zeros of the Riemann zeta function.
- Implemented the Riemann–Siegel formula in combination with the Cauchy–Schlömilch transformation.
- Investigated Lehmer’s phenomenon and the distribution of spacing between zeros.

Data Science

Hugging Face

Online

Transformers and Natural Language Processing

2024–2025

Manning

Ann Arbor, MI

Build a Large Language Model (From Scratch)

2024–2025

Coursera

Online

Generative AI for Everyone

2024

Manning

Ann Arbor, MI

Deep Learning with Python

2023–2024

Thinkful

Online

Data Science Bootcamp

2023–2024

DataQuest

Online

Data Science in Python

2023

Coursera

Online

DeepLearning.AI Deep Learning Specialization

2022

Presentations

2025: Applications of Machine Learning in Cancer Prediction and Prognosis. Ann Arbor Machine Learning Group. [Notebook](#).

2025: Building and fine-tuning a GPT model to produce song lyrics. Data Science & Machine Learning Collaborative Learning Group. [Notebook](#).

2025: Sharing models, tokenizers, and the Datasets library in Hugging Face. Applied Machine Learning Group.

2025: Physics-Informed Neural Networks (PINNs) and Scientific Machine Learning. Ann Arbor Machine Learning Group. [Notebook](#).

2025: Single-Head and Multi-Head Self-Attention. Data Science & Machine Learning Collaborative Learning Group.

2025: Career Panel Discussion for Mathematical Scientists. Joint Mathematics Meeting 2025. [AMS Special Session](#)

2024: Tokenization, sequences, and attention masks with Hugging Face. Applied Machine Learning Group.

2024: Transformers and pretrained models in Hugging Face. Applied Machine Learning Group.

2024: Building a NLP Information Retrieval System with Trip Advisor. Ann Arbor Machine Learning Group. [Notebook 1](#), [Notebook 2](#), [Dash App](#).

2024: Scaling-up model training with GPUs and TPUs. Data Science & Machine Learning Collaborative Learning Group.

2024: Generative Adversarial Networks and Unsupervised Learning. Data Science & Machine Learning Collaborative Learning Group.

2024: Neural Style Transfer, Variational Autoencoders, and Supervised Learning. Data Science & Machine Learning Collaborative Learning Group.

2023: Transformers and Natural Language Processing. Data Science & Machine Learning Collaborative Learning Group.

2023: Climate Change: Modeling Earth Surface Temperatures. Ann Arbor Machine Learning Group. [Notebook](#).

2023: Deep Learning for Timeseries. Data Science & Machine Learning Collaborative Learning Group.

2023: Interpreting what convnets learn. Data Science & Machine Learning Collaborative Learning Group. [Slides](#).

2022: Joint Analyticity of the TFE Method and DNO in Periodic Media, Thesis Defense. [Slides](#).

2022: Wave Scattering in Periodic Media, Graduate Student Colloquium, Graduate student talk. [Slides](#).

2021: Calculating zeros of the Riemann zeta function, UIC Math Club, Graduate student talk. [Slides](#).

2020: The FROST and FROSTb Models, Summary of research performed at summer internship, CRREL. Graduate student talk. [Slides](#).

2019: Parallel Iterative Tomographic Reconstruction, LANS Summer Argonne Students Symposium, Argonne National Laboratory. Graduate student talk. [Slides](#).

2018-2021: UIC Graduate Analysis and Applied Mathematics Seminar

- Water Waves, Shallow-Water Equations, and Tsunamis (10/20/2021)
- Applications of Pseudo-differential operators (04/08/2021)
- Pseudo-differential operators on \mathbb{R}^n (03/25/2021)
- High-Order Perturbation of Surfaces (HOPS) Method (02/11/2021)
- The Riemann zeta function and Padé approximants (11/07/2018)

2013: Calculating the radiant of the Perseid meteor shower, CUREA Program Physics 2013. Undergraduate student talk. [CUREA Reflections 2013](#).

Workshops and Summer Schools

Argonne National Laboratory	Virtual School
<i>Argonne Leadership Computing Facility (ALCF) AI for Science Training Series</i>	<i>2021–2022</i>
Mathematical Sciences Research Institute	Virtual School
<i>Graduate Summer School on Mathematics of Big Data: Sketching and Linear Algebra</i>	<i>2021</i>
Mathematical Sciences Research Institute	Virtual School
<i>Graduate Summer School on Microlocal Analysis: Theory and Applications</i>	<i>2021</i>
Mathematical Sciences Research Institute	Virtual Workshop
<i>Workshop for Recent Developments in Fluid Dynamics</i>	<i>2021</i>
Mathematical Sciences Research Institute	Virtual School
<i>Graduate Summer School on Water Waves</i>	<i>2020</i>
Toyota Technological Institute at Chicago	Chicago, IL
<i>Summer School on Machine Learning</i>	<i>2018</i>

Computer Skills

Tools and Languages: Python, Julia, Matlab, Bash, C++, \LaTeX

Packages: Tensorflow, Keras, PyTorch, Scikit-Learn, NumPy, SciPy, Matplotlib, Chebfun

Quantitative Research: Mathematical Optimization, Mathematical Modeling, SQL

OS: Linux, Windows

Projects: [Data Science](#), [Machine Learning](#), [Computational Electromagnetics](#), [Computational Number Theory](#)

Honors and Awards

2022: Graduate Student Travel Grant (JMM 2022), American Mathematical Society

2021–2022: Victor Twersky Memorial Scholarship, University of Illinois at Chicago

2014–2015: Applied and Computational Mathematics Graduate Scholarship, University of Michigan at Dearborn

2010: Alumni Association Scholarship, Oakland University

2009: Member of Omicron Delta Epsilon (International Honor Society in Economics)

References

David Nicholls

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Gerard Awanou

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University of Illinois at Chicago
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Jerry Bona

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John Steenbergen (Teaching)

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University of Illinois at Chicago
Chicago, IL 60607
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Leadership and Membership

Co-organizer of Ann Arbor AI/ML Meetup Group

Co-organizer of Data Science and Machine Learning Collaborative Learning Meetup Group

American Mathematical Society (AMS)

Society for Industrial and Applied Mathematics (SIAM)