

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 statistical analysis
- Acoustics and electromagnetics
- High performance computing
- Calculating zeros of the Riemann zeta function

Education

University of Illinois at Chicago

Ph.D. in Applied Mathematics

Chicago, IL

2018–2022

Advisor: [Professor David Nicholls](#)

Thesis: [Joint Analyticity of the Transformed Field and Dirichlet-Neumann Operator in Periodic Media](#)

University of Michigan at Dearborn

M.S. in Computational Mathematics

Dearborn, MI

2013–2015

Advisor: [Professor Frank Massey](#)

MS Project: [Computational methods for the Riemann zeta function](#)

University of Otago

Exchange student

Dunedin, New Zealand

2010

Oakland University

B.A. in Economics

Rochester, MI

2006–2010

Employment and Internships

Michigan Tech Research Institute

Research Scientist

Ann Arbor, MI

August 2022 – Present

University of Illinois at Chicago

Graduate Research and Teaching Assistant

Chicago, IL

2018–July 2022

Cold Regions Research and Engineering Laboratory

NSF Mathematical Sciences Graduate Internship

Hanover, NH

Summer 2020

Argonne National Laboratory

NSF Mathematical Sciences Graduate Internship

Lemont, IL

Summer 2019

Workforce Software

Software Consultant/Programmer

Livonia, MI

2010–2017

Oakland University

Web Developer

Rochester, MI

2009–2010

Spec Associates

Strategic Research Intern

Detroit, 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 – [Manuscript](#). Submitted.
- 2: M. Kehoe and D. Nicholls, Joint Geometry/Frequency Analyticity of Fields Scattered by Periodic Layered Media – [Manuscript](#). Published in the SIAM Journal on Mathematical Analysis.

Teaching Experience

University of Illinois at Chicago

Chicago, IL

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

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

Research

Computational Electromagnetics and Signal Processing

2022–2022

- 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

Thesis

High-Order Perturbation of Surfaces (HOPS)

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

Virtual Summer Internship

Mathematics Research 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

Summer Internship

Mathematics Research 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.

- 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.

Presentations

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

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.

2019: Parallel Iterative Tomographic Reconstruction, LANS Summer Argonne Students Symposium, Argonne National Laboratory. Graduate student talk.

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 <i>Argonne Leadership Computing Facility (ALCF) AI for Science Training Series</i>	Virtual School 2021–2022
Mathematical Sciences Research Institute <i>Graduate Summer School on Mathematics of Big Data: Sketching and Linear Algebra</i>	Virtual School 2021
Mathematical Sciences Research Institute <i>Graduate Summer School on Microlocal Analysis: Theory and Applications</i>	Virtual School 2021
Mathematical Sciences Research Institute <i>Workshop for Recent Developments in Fluid Dynamics</i>	Virtual Workshop 2021
Mathematical Sciences Research Institute <i>Graduate Summer School on Water Waves</i>	Virtual School 2020
Toyota Technological Institute at Chicago <i>Summer School on Machine Learning</i>	Chicago, IL 2018
CUREA Program Physics <i>Summer School on Observational Astronomy</i>	Pasadena, CA 2013

Computer Skills

Tools and Languages: Python, Julia, Git, Matlab, \LaTeX , Bash, Java, C++, Fortran, Jira, Qiskit

Packages: NumPy, Matplotlib, Chebfun, Tensorflow, Keras

Quantitative Research: Mathematical Optimization, Mathematical Modeling, SQL

OS: Linux, Windows

Projects: [Data Analysis](#), [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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University of Illinois at Chicago
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Gerard Awanou

Department of Mathematics
University of Illinois at Chicago
Chicago, IL 60607
✉ awanou@uic.edu

Jerry Bona

Department of Mathematics
University of Illinois at Chicago
Chicago, IL 60607
✉ jbona@uic.edu

John Steenbergen (Teaching)

Department of Mathematics
University of Illinois at Chicago
Chicago, IL 60607
✉ jbergen@uic.edu

Membership

American Mathematical Society (AMS)

Society for Industrial and Applied Mathematics (SIAM)