Matthew Kehoe

Data/Research Scientist

248-224-1543 • mkehoe5@uic.edu • matthewshawnkehoe.github.io
www.linkedin.com/in/matthew-kehoe-73669135

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 — **Chicago, IL**
Ph.D. in Applied Mathematics — *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 — **Dearborn, MI**
M.S. in Computational Mathematics — *2013–2015*
Advisor: Professor Frank Massey
MS Project: Computational methods for the Riemann zeta function

University of Otago — **Dunedin, New Zealand**
Exchange student — *2010*

Oakland University — **Rochester, MI**
B.A. in Economics — *2006–2010*

Employment and Internships

Michigan Tech Research Institute — **Ann Arbor, MI**
Research Scientist — *August 2022 – Present*

University of Illinois at Chicago — **Chicago, IL**
Graduate Research and Teaching Assistant — *2018–July 2022*

Cold Regions Research and Engineering Laboratory — **Hanover, NH**
NSF Mathematical Sciences Graduate Internship — *Summer 2020*

Argonne National Laboratory — **Lemont, IL**
NSF Mathematical Sciences Graduate Internship — *Summer 2019*

Workforce Software — **Livonia, MI**
Software Consultant/Programmer — *2010–2017*

Oakland University — **Rochester, MI**
Web Developer — *2009–2010*

Spec Associates — **Detroit, MI**
Strategic Research Intern — *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.

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.

Presentations

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 Pertubation 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**
Argonne Leadership Computing Facility (ALCF) AI for Science Training Series *2021–2022*

Mathematical Sciences Research Institute **Virtual School**
Graduate Summer School on Mathematics of Big Data: Sketching and Linear Algebra *2021*

Mathematical Sciences Research Institute **Virtual School**
Graduate Summer School on Microlocal Analysis: Theory and Applications *2021*

Mathematical Sciences Research Institute **Virtual Workshop**
Workshop for Recent Developments in Fluid Dynamics *2021*

Mathematical Sciences Research Institute **Virtual School**
Graduate Summer School on Water Waves *2020*

Toyota Technological Institute at Chicago **Chicago, IL**
Summer School on Machine Learning *2018*

CUREA Program Physics **Pasadena, CA**
Summer School on Observational Astronomy *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
Department of Mathematics
University of Illinois at Chicago
Chicago, IL 60607
davidn@uic.edu

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

Gerard Awanou
Department of Mathematics
University of Illinois at Chicago
Chicago, IL 60607
awanou@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)