Mary Vaughan

CONTACT Information Department of Mathematics and Statistics The University of Western Australia

35 Stirling HWY

Crawley WA 6009 Australia

EDUCATION

Iowa State University, Ames, IA

2015-2020

Email: mary.vaughan@uwa.edu.au

Website: maryvaughan.github.io

Ph.D. in Mathematics

- Dissertation Title: Analysis of nonlocal equations: One-sided weighted fractional Sobolev spaces and Harnack inequality for fractional nondivergence form elliptic equations
- Advisor: Pablo Raúl Stinga

University of Wisconsin-La Crosse, La Crosse, WI

2011-2015

B.S. in Mathematics, minor in chemistry

CURRENT EMPLOYMENT

Research Associate

Aug 2023-present

The University of Western Australia, Department of Mathematics and Statistics

♦ Supervisors: Serena Dipierro and Enrico Valdinoci

Previous Employment

RTG Postdoctoral Researcher

Aug 2020-May 2023

The University of Texas at Austin, Department of Mathematics

♦ Supervisors: Luis Caffarelli and Stefania Patrizi

Graduate Teaching Assistant

Aug 2015-Aug 2020

Iowa State University, Department of Mathematics

RESEARCH INTERESTS

Partial Differential Equations and Harmonic Analysis

Nonlocal equations, fractional derivatives, fractional Laplacians, nonlinear equations, regularity theory, Harnack inequalities, fractional Allen–Cahn, Gamma convergence, symmetrization techniques, materials modeling, viscoelasticity, peridynamics, fractals and graphs, Kaczmarz algorithm

PUBLICATIONS

- [1] P. R. Stinga and M. Vaughan, Interior Schauder estimates for fractional elliptic equations in nondivergence form, *submitted* (2024), 43 pp.
- [2] M. G. Delgadino and M. Vaughan, Continuous symmetrizations and uniqueness of solutions to nonlocal equations, *submitted* (2023), 35 pp.
- [3] S. Patrizi and M. Vaughan, Multiple interphases for fractional Allen–Cahn equations, *preprint* (2023), 70 pp.
- [4] P. R. Stinga and M. Vaughan, Fractional elliptic equations in nondivergence form: definition, applications and Harnack inequality, *J. Math. Pures Appl.* **156** (2021), 245–306.
- [5] P. R. Stinga and M. Vaughan, Fractional derivatives, fractional Laplacians, and weighted Sobolev spaces, *Nonlinear Anal.* **193** (2020), 29 pp.

[6] A. Aboud, E. Curl, S. N. Harding, M. Vaughan, and E. S. Weber, The dual Kacz-marz algorithm, Acta Appl Math 165 (2020), 133–148.

Papers in Preparation

- [7] S. Dipierro, S. Patrizi, E. Valdinoci, and M. Vaughan, Asymptotic expansion of a nonlocal phase transition energy.
- [8] A. Aboud, P. Alonso Ruiz, T. Das, and M. Vaughan, Finite graph approximations for nonlocal energies on fractal domains.
- [9] P. Seleson, P. R. Stinga, and M. Vaughan, Fracture criteria for peridynamic models.
- [10] P. Seleson, P. R. Stinga, and M. Vaughan, Peridynamic models for viscoelastic materials.

FELLOWSHIPS AND INTERNSHIPS

Robert J. Lambert Graduate Assistantship

Spring 2020

Iowa State University, Department of Mathematics

Teaching release awarded to one graduate student to improve the quantity and quality of research

Brown Graduate Fellowship, \$10,000

Fall 2019-Spring 2020

Iowa State University, Office of the Vice President for Research One of twelve graduate students across campus to receive this award

NSF-MSGI Summer Internship

Summer 2018

Fractional PDEs for materials modeling under the direction of Pablo Seleson at Oak Ridge National Laboratory. One of twenty students selected

GRANTS AND FUNDING

Structured Quartet Research Ensembles (SQuaREs)

2021-2024

AIM Institute, San Jose, CA, Pasadena, CA Proposal title: Fractional Laplacians on Fractal Domains

Graduate Student Travel Grant. \$250

October 2018

American Mathematical Society

Purpose: Invited to present at AMS Sectional Meeting in Ann Arbor, MI

Inclusion Initiatives Grant (Co-PI), \$1,580

May 2018

Iowa State University, Office of the Vice President for Diversity and Inclusion Purpose: Host the Midwest Mathematics Inclusion and Diversity Workshop for Undergraduates, October 2018

Women's and Diversity Grant Award (Co-PI), \$5,000

May 2017

Iowa State University, Office of the Vice President for Diversity and Inclusion Purpose: Host the first Joint EDGE-MOCA Speaker Series, 2018-19

Honors and Awards

Honorable Mention in the Elevating Mathematics Video Competition March 2019
National Academies' Board on Mathematical Science and Analytics
Video found at https://youtu.be/tSylHPE6WKk

Robert J. Lambert Research Award, \$1,000

Fall 2018

Iowa State University, Department of Mathematics Awarded to one graduate student for research excellence INVITED CONFERENCE TALKS

- [1] at the Geometry of Measures and Free Boundaries 2024, a Conference in Honor of Tatiana Toro, Seattle, WA. July 2024 upcoming
- [2] Interior regularity theory for fractional elliptic equations in nondivergence form, at the MATRIX event Elliptic Partial Differential Equations, Geometry, and the Calculus of Variations, Creswick, Australia. January 2024
- [3] Multiple interphases for fractional Allen–Cahn equations at AMS Sectional Meeting, Special Session on Geometric and Analytic methods in PDE, Cincinnati, OH. April 2023
- [4] Multiple interphases for fractional Allen–Cahn equations (seminar length) at the Midwest Geometry Conference, Manhattan, Kansas. March 2023
- [5] Dynamics for loop dislocations in crystals (seminar length) at the MATRIX event Minimal Surfaces and Geometric Flows: Interaction Between the Local and the Nonlocal Worlds, Creswick, Australia. January 2023
- [6] Dynamics for loop dislocations in crystals at Joint Mathematics Meetings, Special Session on Advances in Nonlinear Boundary Value Problems, Boston, MA. January 2023
- [7] Fractional energies, symmetrizations, and applications at Joint Mathematics Meetings, Special Session on Nonlocal Frameworks in Analysis and Mathematical Modeling, Boston, MA. January 2023
- [8] Fractional powers of nondivergence form elliptic operators at Advances in Operator Theory with Applications to Mathematical physics, Chapman University, Orange, CA. November 2022
- [9] Recent progress on crystal dislocation dynamics in higher dimensions at the Banff International Research Station, Theoretical and Applied Aspects for Nonlocal Models workshop, Alberta, CA. July 2022
- [10] Crystal dislocation dynamics in higher dimensions (seminar length) at Nonlocal School on Fractional Equations 2022, Ames, IA. June 2022
- [11] Fractional derivatives and characterizations of one-sided weighted Sobolev spaces at Joint Mathematics Meetings, AMS Special Session on Recent Developments in Nonlocal Modeling and Analysis, Seattle, WA. April 2022
- [12] Internships and fractional derivatives at Oak Ridge National Laboratory at Joint Mathematics Meetings, SIAM Special Session on Graduate Research in Industry and National Laboratory Internships, Seattle, WA. April 2022
- [13] Harnack inequality for fractional elliptic equations in nondivergence form at 16th U.S. National Congress on Computational Mechanics, Chicago, IL. July 2021
- [14] Fractional derivatives and characterizations of one-sided weighted Sobolev spaces (seminar length) at Young Researchers Minisymposium, Okinawa Institute of Science and Technology, Japan. February 2020
- [15] Fractional derivatives in one-sided weighted Sobolev spaces at SIAM Central States Section, Ames, IA. October 2019

[16] Fractional derivatives in one-sided weighted Sobolev spaces at AMS Sectional Meeting, Special Session on Recent Trends on Local, Nonlocal and Fractional Partial Differential Equations, Ann Arbor, MI. October 2018

INVITED SEMINARS AND COLLOQUIUM

- [1] Evolution of dislocations in crystalline structures at Colloquia, University of Nebraska-Lincoln, NE. April 2023.
- [2] Application of continuous Steiner symmetrizations to fractional equations at Continuum Mechanics Seminar, University of Nebraska-Lincoln, NE. April 2023.
- [3] Regularity theory for fractional elliptic equations in nondivergence form at Geometry and Analysis Seminar, Columbia University, NY. March 2023
- [4] Application of continuous Steiner symmetrizations to fractional equations at Nonlinear Partial Differential Equations Seminar, Wayne State University, MI. February 2023
- [5] Regularity theory for fractional elliptic equations in nondivergence form at Nonlinear Partial Differential Equations Seminar, Texas A&M University, TX. November 2022
- [6] What is a fractional derivative? at Colloquia, Westmont College, CA. November 2022
- [7] Harnack inequality for fractional elliptic equations in nondivergence form at AIMS-Cameroon Research Center Colloquium Series, African Institute for Mathematical Science, Cameroon. December 2021.
- [8] Harnack inequality for fractional elliptic equations in nondivergence form at Analysis Seminar, The University of Texas at Austin. December 2021.
- [9] Harnack inequality for fractional elliptic equations in nondivergence form at Continuum Mechanics Seminar, University of Nebraska-Lincoln, NE. March 2021
- [10] An introduction to the nonlocal Peierls-Nabarro model in 1D at SIAM Student Chapter, Iowa State University, IA. March 2021
- [11] A priori estimates for fractional powers of nondivergence form elliptic operators at PDE & Analysis Seminar, University of Pittsburgh, PA. February 2020
- [12] What is a fractional derivative? at Colloquia, Carleton College, MN. November 2019
- [13] Viscoelasticity and Fractional Derivatives at Continuum Mechanics Seminar, University of Nebraska–Lincoln, NE. April 2019
- [14] How to define fractional Laplacians and fractional derivatives at Continuum Mechanics Seminar, University of Nebraska–Lincoln, NE. April 2018
- [15] A brief history and comparison of fractional derivatives at UWL Math Club, University of Wisconsin–La Crosse, WI. November 2018
- [16] Two talks: the truth about graduate school and what is a fractional derivative? at UWL Math Club, University of Wisconsin–La Crosse, WI. November 2017

OTHER TALKS

Conference talks

[1] Evolution of interfaces in the limit of a nonlocal phase field model at Texas Differential Equations Conference, College Station, TX. October 2022

- [2] Harnack inequality for fractional elliptic equations in nondivergence form at AMS Sectional Meeting, Special Session on Theoretical and Applied Aspects of Nonlocal Equations, Omaha, NE. October 2021.
- [3] A priori estimates for fractional powers of nondivergence form elliptic operators at Texas Differential Equations Conference, Austin, TX. March 2020
- [4] One-sided fractional derivatives and weighted Sobolev spaces at Joint Mathematics Meeting, Denver, CO. January 2020
- [5] Fractional derivatives and one-sided weighted Sobolev spaces at 7th Midwest Women in Mathematics Symposium, Iowa City, IA. April 2019
- [6] Investigating the dependence of transmission rate to water temperature in a host-parasite system at Wisconsin MAA Section Meeting, Ripon College, WI. April 2015
- [7] Investigating the dependence of transmission rate to water temperature in a host-parasite system at Joint Mathematics Meeting, San Antonio, TX. January 2015

Seminars

- [1] Fractional powers of nondivergence form elliptic operators at Junior Analysis Seminar, Iowa State University, IA. January 2020
- [2] Viscosity Solutions of Elliptic Equations (2 Days) at Junior Analysis Seminar, Iowa State University, IA. October & November 2019
- [3] Fractional derivatives in one-sided weighted Sobolev spaces at SIAM Seminar, Iowa State University, IA. November 2018
- [4] What are fractional derivatives? at Graduate Student Seminar, Iowa State University, IA. September 2018.
- [5] Fractional PDEs for materials modeling at Computational and Applied Mathematics Seminar, Oak Ridge National Laboratory, TN. August 2018
- [6] How to define fractional Laplacians and fractional derivatives at Analysis Seminar, Iowa State University, IA. April 2018
- [7] Investigating the dependence of transmission rate to water temperature in a host-parasite system at Mathematics Department Colloquium, University of Wisconsin—La Crosse, WI. October 2014
- [8] Investigating the dependence of transmission rate to water temperature in a host-parasite system at Mathematics-Biology Working Group, University of Wisconsin—La Crosse, WI. October 2014
- [9] Investigating the dependence of transmission rate to water temperature in a host-parasite system at Dean's Distinguished Fellowship Meeting, University of Wisconsin–La Crosse, WI. July 2014

POSTER PRESENTATIONS

- [1] Viscoelasticity and fractional derivatives at Workshop on Experimental and Computational Fracture Mechanics, Baton Rouge, LA. February 2020
- [2] Fractional derivatives and Laplacians in one and two-sided weighted Sobolev spaces at the 2020 Joint Mathematics Meeting, Denver, CO. January 2020
- [3] Fractional derivatives and Laplacians in one and two-sided weighted Sobolev spaces at Local and Nonlocal Trends in Analysis and Geometry, Pittsburgh, PA. October 2019

- [4] Fractional derivatives and Laplacians in one and two-sided weighted Sobolev spaces at SIAM Conference on Computational Science and Engineering, Spokane, WA. February 2019
- [5] Fractional PDEs for materials modeling at ORPA Research Symposium, Oak Ridge National Laboratory, TN. August 2018
- [6] Investigating the dependence of transmission rate to water temperature in a hostparasite system at Midwest Mathematical Biology Conference, University of Wisconsin– La Crosse, WI. May 2015
- [7] Investigating the dependence of transmission rate to water temperature in a host-parasite system at Joint Mathematics Meeting, San Antonio, TX. January 2015
- [8] Investigating the dependence of transmission rate to water temperature in a hostparasite system at Summer Research Expo, University of Wisconsin-La Crosse, WI. August 2014

Conference Attendance

- [1] Geometry of Measures and Free Boundaries 2024, a Conference in Honor of Tatiana Toro, Seattle, WA. July 2024 - upcoming
- [2] The MATRIX-RIMS Tandem Workshop: Evolutionary Partial Differential Equations and Applications, Creswick, Australia. March 2024
- [3] The MATRIX event Elliptic Partial Differential Equations, Geometry, and the Calculus of Variations, Creswick, Australia. January 2024
- [4] AMS Sectional Meeting, Special Session on Geometric and Analytic methods in PDE, Cincinnati, OH. April 2023
- [5] Midwest Geometry Conference, Manhattan, Kansas. March 2023
- [6] The MATRIX event Minimal Surfaces and Geometric Flows: Interaction Between the Local and the Nonlocal Worlds, Creswick, Australia. January 2023
- [7] Joint Mathematics Meetings, Boston, MA. January 2023.
- [8] Advances in Operator Theory with Applications to Mathematical physics, Orange, CA. November 2022.
- [9] Texas Differential Equations Conference, College Station, TX. October 2022.
- [10] Nonlocal School on Fractional Equations 2022, Ames, IA. June 2022.
- [11] Joint Mathematics Meetings, Seattle, WA. April 2022.
- [12] AMS Fall Central Sectional Meeting, Omaha, NE. October 2021
- [13] 16th U.S. National Congress on Computational Mechanics, Chicago, IL. July 2021
- [14] The 50th John H. Barrett Memorial Lectures, Knoxville, TN. May 2021
- [15] Texas Differential Equations Conference, Austin, TX. March 2020
- [16] Workshop on Experimental and Computational Fracture Mechanics, Baton Rouge, LA. February 2020
- [17] Young Researchers Minisymposium, Onna, Okinawa, Japan. February 2020
- [18] Joint Mathematics Meetings, Denver, CO. January 2020
- [19] SIAM Central States Section, Ames, IA. October 2019

- [20] Local and Nonlocal Trends in Analysis and Geometry, Pittsburgh, PA. October 2019
- [21] Midwest Geometry Conference 2019, Ames, IA. September 2019
- [22] 7th Midwest Women in Mathematics Symposium, Iowa City, IA. April 2019
- [23] SIAM Conference on Computational Science and Engineering, Spokane, WA. February 2019
- [24] AMS Sectional Meeting, University of Michigan, MI. October 2018
- [25] NSF CBMS Conference on Harmonic Analysis: Smooth and Non-Smooth, Iowa State University, IA. June 2018
- [26] Rivière-Fabes Symposium, University of Minnesota, MN. May 2018
- [27] Midwest Women in Mathematics Symposium, Purdue University, IN. April 2018
- [28] February Fourier Talks, University of Maryland, MD. February 2018
- [29] Nonlocal School on Fractional Equations, Iowa State University, IA. August 2017
- [30] Iowa Nebraska Functional Analysis Seminar, Creighton University, NE. April 2017
- [31] Workshop on Noncommutative Analysis, University of Iowa, IA. June 2016
- [32] Thematic Program on Boundaries and Dynamics, Undergraduate Summer School, University of Notre Dame, IN. May 2015
- [33] Midwest Mathematical Biology Conference, University of Wisconsin–La Crosse, WI. May 2015
- [34] Wisconsin MAA Section Meeting, Ripon College, TX. April 2015
- [35] Joint Mathematics Meetings, San Antonio, TX. January 2015

TEACHING EXPERIENCE

The University of Texas at Austin

M 427L: Adv. Calculus for Applications II	120 students	Spring 2023
M 361K: Introduction to Real Analysis	25 students	Fall 2022
M 427J: Differential Equations with Linear Alg.	100 students	Spring 2022
M 427J: Differential Equations with Linear Alg.	100 students	Fall 2021
M 427L: Adv. Calculus for Applications II	120 students	Spring 2021
M 408L: Integral Calculus (flipped classroom)	32 students	Fall 2020

Iowa State University

Sole Instructor

Math 266/7: Elementary Differential Equations	18 students	Summer 2019
Math 166: Calculus II	35 students	Spring 2018
Math 166: Calculus II	35 students	Summer 2017

Teaching Assistant

Math 165: (Calculus I (flipped classroom)	Team-Based Learning	Fall 2017
Math 160: S	Survey of Calculus		Fall 2016
Math 265: (Calculus III		Spring 2016
Math 166: (Calculus II		Fall 2015

Grader

Math 554: Stochastic Processes	Fall 2019
Math 519: Applied of Math I	Fall 2019
Math 365: Complex Variables	Spring 2017
Math 105: Intro to Math Ideas	Spring 2017
Math 265: Calculus III	Summer 2016
Math 143: Pre-Calculus	Summer 2016

TEACHING DEVELOPMENT

Attended active learning workshop, the University of Texas (3 hours) August 2021

Team Based Learning Curriculum Assistant

Fall 2018–Spring 2019

Funded through the Howard Hughes Medical Institute grant Goal: Develop Team Based Learning material for non-TBL instructors to implement active learning in non-TBL classes

Teaching Seminar on the Book Make It Stick - The Science of Successful Learning by Peter C. Brown

Co-leader of seminar	Spring 2019
Participant of seminar	Spring 2017

Professional Service

Conference organization

- Organizer of the Special Session on Theoretical and Applied Aspects of Nonlocal Equations at AMS Sectional Meeting, Omaha, NE. (joint with Animesh Biswas and Petronela Radu)
- Organizer of the Midwest Mathematics Inclusion and Diversity Workshop for Undergraduates at Iowa State University, Ames IA. (joint with a team of ISU mathematics graduate students and faculty) October 2018 website: https://sites.google.com/iastate.edu/mmidwu18/

Seminar organization

- Co-founder and organizer of Junior Analysis Seminar at Iowa State University (joint with Animesh Biswas)
 2019-2020
 website: https://sites.google.com/view/junior-analysis-seminar/home

Conference assistance

- ♦ Assisted with preparations of Texas Women in Math Symposium 2023 at the University of Texas March 2023
- ♦ Assisted with registration and organization of Midwest Geometry Conference 2019 at Iowa State
 September 2019
- Assisted with student activities and organization of Sonia Kovalevsky Mathematics Day at Iowa State
 March 2019
- ♦ Great Plains Math League Competition volunteer February 2016, 2017

Referee for peer-reviewed journals

- ♦ Journal of Evolution Equations
- ♦ Nonlinear Analysis
- ♦ Rocky Mountain Journal of Mathematics
- ♦ The Royal Society of Edinburgh: Proceedings A

Center for Minorities in the Mathematical Sciences

 Research assistantship under the supervision of Michael Young to develop content for the CMMS website: minoritymath.org
 Summer 2020

Mentoring

- ♦ Mentored a female undergraduate math major as part of the SAGES at UT mentorship program
 2022
- $\diamond\,$ First-year graduate peer mentor, Iowa State

2016-2020

Committees

- ♦ Elected Member of Math Graduate Student Organization at Iowa State
 - Treasurer 2016-2017
 - Graduate Student Liaison

2017-2018

- ♦ Association for Women in Mathematics Student Chapter at Iowa State
 - Co-founder and member

November 2017-August 2020

• Interim Secretary

- November 2017-February 2018
- Member of Program and Events Committee

November 2017-August 2018

Memberships

Australian Mathematica Society

AustMS Women in Mathematics Special Interest Group

Undergraduate Highlights

Dean's Distinguished Summer Fellowship, \$4,000

Summer 2014

University of Wisconsin–La Crosse, College of Science and Health Mentor: James Peirce

Student Travel Grant. \$400

Fall 2015

University of Wisconsin–La Crosse

Purpose: Present at the Joint Mathematics Meetings in San Antonio, TX

Outstanding Work in Mathematics Award

Spring 2014, 2015

University of Wisconsin–La Crosse, Department of Mathematics

Freshmen Chemist of the Year

Spring 2012

University of Wisconsin–La Crosse, Department of Chemistry

Teaching experience

Mathematics Tutor Young Scholars Teaching Assistant Fall 2013 - Spring 2015

Summer 2014

OTHER Citizenship

♦ United States of America

\diamond Ireland

Certifications

♦ Certified Completion of Green Dot Bystander Training	2018
♦ CPR, AED, first aid, lifeguarding	2009-2015

Previous employment

♦ Summer lifeguard	2009-2015
♦ Swim lesson instruction	2011-2015
♦ Special Olympics swim coach	2014

Martial Arts

- \diamond Black Belt in Karate
- \diamond Blue Belt in Taekwondo

References

Patricia Alonso Ruiz (paruiz@tamu.edu)

Assistant Professor Department of Mathematics Texas A&M University

Heather Bolles (hbolles@iastate.edu)

Associate Teaching Professor Department of Mathematics, Iowa State University $Teaching\ Reference$

Stefania Patrizi (spatrizi@math.utexas.edu)

Assistant Professor Department of Mathematics The University of Texas at Austin

Pablo Raúl Stinga (stinga@iastate.edu)

Associate Professor, Director of Diversity Department of Mathematics, Iowa State University $Ph.D.\ Advisor$

${\bf Enrico\ Valdinoci\ (enrico.valdinoci@uwa.edu.au)}$

Professor

Department of Mathematics and Statistics The University of Western Australia