

John T. Nardini

Postdoctoral Scholar
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Education

- Ph.D., Applied Mathematics** 2018
University of Colorado, Boulder, CO
Dissertation Title: PDE Models of Collective Migration During Wound Healing
Adviser: David M. Bortz
Certificate in Interdisciplinary Quantitative Biology
- M.S., Applied Mathematics** 2016
University of Colorado, Boulder, CO
- B.S., Mathematics** 2013
N.C. State University, Raleigh, NC

Research Interests

- Mathematical Modeling of Cell Migration
- Analysis and Simulation of Partial Differential Equations
- Application of Machine Learning to Inverse Problems and Math Modeling

Research Experience

- Postdoctoral Fellow** 2018-Present
Joint Position at N.C. State University & SAMSI
Developing machine-learned approaches for model selection and quantifying cell motility
Adviser: Prof. Kevin B. Flores
- Research Assistant** 2013-18
University of Colorado, Boulder
Deriving and analyzing multiscale PDE models of wound healing
Adviser: Prof. David M. Bortz
- Research Assistant** 2011-13
N.C. State University
Model Selection for flow cytometry experiments
Adviser: Prof. H. T. Banks

Grants and Awards

- Professional Development Award for Postdocs (\$698)** 2019-20
NC State University Graduate School and the Office of Postdoctoral Affairs
Funding to develop innovative metacognitive approaches for undergraduate classrooms

Grants and Awards (cont.)

- SAMSI Postdoctoral Fellowship (\$130,000)** 2018-20
National Science Foundation
Fellowship on SAMSI's program on precision medicine
- Integrative Graduate Education and Research Traineeship Program (\$60,000)** 2013-15
National Science Foundation
Doctoral fellowship to conduct interdisciplinary research

Travel Awards to attend (\$2,000 total):

Society for Mathematical Biology Annual Meetings (2015,2017), Joint Mathematics Meetings (2019), SIAM Conference on the Life Sciences (2016), SIAM Conference on Applications of Dynamical Systems (2017), NC State Tutorial Workshop on Parameter Estimation for Biological Models (2016), AMS Mathematics Research Community on Agent-based Models for Biological and Social systems (2018).

Research Publications

Peer-reviewed articles ([†]denotes equal contribution, Click on DOI to access articles)

1. J. Lagergren[†], **J. Nardini**[†], G. M. Lavigne, E. M. Rutter, K. B. Flores. Learning Partial Differential Equation Models from Noisy Spatiotemporal Data. *Proceedings of the Royal Society A* 476 (2234), 2020 10.1098/rspa.2019.0800.
2. D. Bhaskar, A. Manhart, J. Milzman, **J. Nardini**, K. Storey, C. M. Topaz, L. Ziegelmeier. Analyzing Collective Motion with Machine Learning and Topology. *Chaos: an Interdisciplinary Journal of Nonlinear Science* 29 (12) 123125, 2019. DOI: 10.1063/1.5125493.
3. **J. Nardini**, D. M. Bortz. The influence of numerical error on parameter estimation and uncertainty quantification for advective PDE models. *Inverse Problems* 35 (6) 065003, 2019. DOI: 10.1088/1361-6420/ab10bb.
4. **J. Nardini**, D. M. Bortz. Investigation of a Structured Fisher's Equation with Applications in Biochemistry. *SIAM J. Appl. Math.* 78 (3) 1712, 2018 DOI: 10.1137/16M1108546.
5. **J. Nardini**, D. Chapnick, X. Liu, D. M. Bortz. Modeling keratinocyte wound healing dynamics: cell-cell adhesion promotes sustained collective migration. *J. Theor. Biol.*, 7 July 2016, 103. DOI: 10.1016/j.jtbi.2016.04.015.
6. K. Adoteye, R. Baraldi, K. Flores, **J. Nardini**, H. T. Banks, W. C. Thompson. Correlation of parameter estimators for models admitting multiple parameterizations. *Int. J. Pure Appl. Math.*, 105(3) 497, 2015. DOI: 10.12732/ijpam.v105i3.16.
7. T. Huffman, K. Link, **J. Nardini**, L. Poag, K. Flores, H.T. Banks, B. Biasco, J. Jungfleisch, J. Diez. A mathematical model of RNA3 recruitment in the replication cycle of brome mosaic virus. *Int. J. Pure Appl. Math.*, 92(1) 27, 2014. DOI: 10.12732/ijpam.v92i1.3.
8. H.T. Banks, A. Choi, T. Huffman, **J. Nardini**, L. Poag, W.C. Thompson. Quantifying CFSE label decay in flow cytometry data. *Appl. Math. Lett.*, 26(5) 571, 2013. DOI: 10.1016/j.aml.2012.12.010

Research Publications (cont.)

Submitted

1. R. Everett, K. Flores, N. Henscheid, J. Lagergren, K. Larripa, D. Li, **J. Nardini**, P. Nguyen, E. B. Pittman, E. Rutter. A tutorial Review of Mathematical Techniques for Quantifying Tumor Heterogeneity. Submitted to *Mathematical Biosciences and Engineering*.

Articles in preparation

1. **J. Nardini**[†], J. Lagergren[†], E. Rutter, A. Hawkins-Daarud, L. Curtin, B. Chandler, K. Swanson, K. Flores. Learning Transport PDEs in the Small Time-sample Limit.
2. **J. Nardini**, R. Baker, M. Simpson, K. Flores. Inferring Differential Equation Models from Stochastic ABM simulations.

Teaching Experience

Course Instructor

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| Calculus I for Engineers, APPM 1350 (CU Boulder) | Summer 2017 |
| Calculus for Life and Management Sciences A, MA 131 (NCSU) | Fall 2019 |
| Foundations of Advanced Mathematics, MA 225 (NCSU) | Spring 2020, Fall 2020 |

Guest Lecturer

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| Modeling of Biological Systems, BMA 567 (NCSU) | Fall 2018 |
| Introduction to Machine Learning in Biology, BMA 790 (NCSU) | Fall 2019 |

Teaching Assistant

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| Calculus II for Engineers, APPM 1360 (CU, Boulder) | Spring 2016 |
| Calculus I for Engineers, APPM 1350 (CU, Boulder) | Summer 2016 |
| Pre-Calculus for Engineers, APPM 1235 (CU, Boulder) | Fall 2016 |
| Introduction to Differential Equations, APPM 2360 (CU, Boulder) | Spring 2017 |

Peer Scholar Group

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| TRESTLE Faculty Learning Community on metacognition <i>Met weekly with group of scholars to discuss methods to promote metacognition in the classroom. See final group reflections here.</i> | Spring 2017 |
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Mentoring Experience

Undergraduate Research

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| Allison Duprey, Fanuel Sisay, Natasha Stewart, and Yangxinyu Xie <i>"Sampling for Equation Learning Methods"</i> | Summer 2019 |
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Invited Talks

"Learning PDE Models from Noisy Spatiotemporal Data"

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| Society for Mathematical Biology Annual Meetings, Montreal, Canada | July, 2019 |
| International Conference on Industrial and Applied Mathematics, Valencia, Spain | July, 2019 |
| VCU Biomath Seminar, Richmond, VA | April 2019 |

Invited Talks (cont.)

- “Analyzing Collective Motion with Machine Learning and Topology”**
University of Oxford Mathematical Biology Seminar, Oxford, U.K. February 2020
International Conference on Industrial and Applied Mathematics,
Valencia, Spain July, 2019
- “Parameter Estimation and Uncertainty Quantification in the Presence of Numerical Error”**
NCSU Tutorial Workshop on Parameter Estimation for Biological Models
Raleigh, NC July 2019
- “A Stage-structured Fisher’s Equation with Applications in Biochemistry”**
SIAM Central States Section Meetings, Fort Collins, CO October 2017
Society for Mathematical Biology Annual Meetings, Salt Lake City, UT July 2017
C.U. Complex/Dynamical Systems Seminar, Boulder, CO October 2016
- “Modeling Keratinocyte Wound Healing: Cell-Cell Adhesion Promotes Collective Migration”**
SIAM Meeting on the Life Sciences, Boston, MA July 2016
Society for Mathematical Biology Annual Meetings, Atlanta, GA July 2015

Outreach and Pedagogical Presentations

- “Machine Learning and Math Modelling of Wound Healing”**
Featured on the Pod of Asclepius podcast January, 2020
- “The Topology of Data”**
Lecture at the NCSU SUM Series for Undergraduates, Raleigh, NC November 2019
- “Introduction to Data Science: Classifying Flocks in Biology”**
Plenary lecture at NC Central University’s “Black Men in STEM” Event
Durham, NC April 2019
- “Introductory Data Science: Linear Regression”**
Developed and led hands-on project for the SAMSI-North Carolina
Central University Undergraduate Data-Science workshop March 2019
- “The Mathematics Underlying Cell Migration During Wound Healing”**
Lecture at the Wake Technical Community College STEM Center Speaker
Series, Raleigh, NC January 2019.
- “Mathematical Modeling for Precision Medicine”**
Tutorial at the SAMSI Undergraduate Workshop on Precision Medicine,
Durham, NC October 2018
- “Inverse Problems for Precision Medicine”**
Developed and lead hands-on project at the SAMSI Undergraduate
Workshop on Precision Medicine, Durham, NC October 2018
- “2018 Graduation Special (Part 1)”**
Featured on the How On Earth Podcast May, 2018

Conference Organizing

Data-Driven Methods for Biological Modeling (with Erica Rutter and Kevin Flores)

Minisymposium Organizer at SMB Annual Meetings, Montreal, Canada, July 2019

Data-Driven Mathematical Models of Cell Migration (with Erica Rutter and Kevin Flores)

Minisymposium Organizer at International Conference on Industrial and Applied Mathematics, Valencia, Spain, July 2019

NCSU Postdoctoral Research Symposium

Co-organizer for postdoctoral research symposium at NC State, Raleigh, NC, May 2019

Stage-structured Populations Models in Biology (with David Bortz)

Minisymposium Organizer at SMB Annual Meetings, Salt Lake City, UT, July 2017

Quantitative Biology Symposium: Systems Biology in the Context of Aging and Disease

Co-organizer for student symposium at University of Colorado, Boulder, CO, May 2017

Migration and Signaling Waves in Cellular Biology (with David Bortz)

Minisymposium Organizer at SMB Annual Meetings, Atlanta, GA, July 2015

Outreach and Service

Reviewer for: *Bulletin of Mathematical Biology*, *Journal of Theoretical Biology*, *Inverse Problems*, *Heliyon*, *Engineering Computations*

Boulder Mental Health Partners: Computer and Mathematics Tutor, June 2017 - July 2018

Participated in professional development panels for:

- SAMSI undergraduate workshop on Methods of Uncertainty, February 2019
- SAMSI undergraduate workshop on Precision Medicine, October 2018

Poster Judge, Joint Math Meeting Undergraduate Poster Session, January 2019

Mentor, SMB Annual Meetings, July 2019

Affiliations

Society for Industrial and Applied Mathematics

Society for Mathematical Biology

American Mathematical Society