

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

Data-driven Mathematical Modeling, Analysis and Simulation of Partial Differential Equations,
Agent-based Models, Machine Learning, Topological Data Analysis

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

- (Pending) Joint DMS/NIGMS Initiative NSF 20-575, (\$1,200,000)** 2021-25
National Science Foundation & National Institutes of Health
PI: Kevin Flores, co-PIs: John Nardini, Jason Haugh
Funding to aid research into data-driven agent-based models of wound healing
- AMS-Simons Travel Grant (\$5,000)** 2020-22
American Mathematical Society
Funding to aid in travel for research collaboration
- Professional Development Award (\$698)** 2019-20
NC State University Graduate School and the Office of Postdoctoral Affairs
Funding to develop innovative metacognitive approaches for undergraduate classrooms
- SAMSI Postdoctoral Fellowship (\$130,000)** 2018-20
National Science Foundation
Fellowship on SAMSI's program on precision medicine

Research Publications

Peer-reviewed articles († denotes equal contribution)

12. **J. Nardini**, R. Baker, M. Simpson, K. Flores. Learning differential equation models from stochastic agent-based model simulations. Accepted for *Journal of the Royal Society Interface*. arXiv 2011.08255.
11. J. Lagergren, **J. Nardini**, R. Baker, M. Simpson, K. Flores. Biologically-informed Neural Networks Guide Mechanistic Modeling from Sparse Experimental Data. *PLoS Computational Biology*. 16 (12) 2020. DOI: 10.1371/journal.pcbi.1008462.
10. **J. Nardini**, J. Lagergren, E. Rutter, A. Hawkins-Daarud, L. Curtin, B. Chandler, K. Swanson, K. Flores. Learning Equations from Biological data with Limited Time Samples. *Bulletin of Mathematical Biology* 82 (119) 2020. DOI: 10.1007/s11538-020-00794-z
9. 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. *Mathematical Biosciences and Engineering*. 17(4), 2020. DOI: 10.3934/mbe.2020207.
8. 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. DOI: 10.1098/rspa.2019.0800.
7. 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.
6. **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.
5. **J. Nardini**, D. M. Bortz. Investigation of a Structured Fisher's Equation with Applications in Biochemistry. *SIAM Journal on Applied Mathematics* 78 (3) 1712, 2018. DOI: 10.1137/16M1108546.
4. **J. Nardini**, D. Chapnick, X. Liu, D. M. Bortz. Modeling keratinocyte wound healing dynamics: cell-cell adhesion promotes sustained collective migration. *Journal of Theoretical Biology*., 7 July 2016, 103. DOI: 10.1016/j.jtbi.2016.04.015.
3. K. Adoteye, R. Baraldi, K. Flores, **J. Nardini**, H. T. Banks, W. C. Thompson. Correlation of parameter estimators for models admitting multiple parameterizations. *International Journal of Pure and Applied Mathematics*, 105(3) 497, 2015. DOI: 10.12732/ijpam.v105i3.16.
2. 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. *International Journal of Pure and Applied Mathematics*, 92(1) 27, 2014. DOI: 10.12732/ijpam.v92i1.3.
1. H.T. Banks, A. Choi, T. Huffman, **J. Nardini**, L. Poag, W.C. Thompson. Quantifying CFSE label decay in flow cytometry data. *Applied Mathematics Letters*., 26(5) 571, 2013. DOI: 10.1016/j.aml.2012.12.010

Articles in review

1. **J. Nardini**, B. Stolz, H. Harrington, K. Flores, H. Byrne. Topological data analysis distinguishes parameter regimes in the Anderson-Chaplain model of angiogenesis. arXiv 2101.00523.

Teaching Experience

Course Instructor

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
Applied Differential Equations, MA 341 (NCSU)	Spring 2021

Guest Lecturer

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

Teaching Experience (cont.)

Teaching Assistant

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 Groups

AMS Project NExT <i>Professional development program incorporating inclusive teaching methods into math classrooms.</i>	2020-21
TRESTLE Faculty Learning Community on metacognition <i>Met weekly with group of scholars to discuss methods to promote metacognition in the classroom.</i>	Spring 2017

Mentoring Experience

Undergraduate Research

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

"Topology Discriminates Models of Angiogenesis"

U. Nottingham Mathematical Medicine and Biology Virtual Seminar, held virtually	March 2021
AMS-MAA Joint Math Meetings session, held virtually	January 2021
Second Symposium on Machine Learning and Dynamical Systems, held virtually	September 2020

"Learning Equations from Biological Data with Limited Time Samples"

University of Colorado, Boulder Biomath Seminar, held virtually	November 2020
Data Science, Statistics, and Visualization Conference, held virtually	July 2020
SIAM Conference on the Life Sciences, cancelled due to Covid-19	June 2020
SIAM Conference on the Mathematics of Data Science, held virtually	June 2020

"Analyzing Collective Motion with Machine Learning and Topology"

Society for Mathematical Biology Annual Meetings, held virtually	August 2020
University of Oxford Mathematical Biology Seminar, Oxford, U.K.	February 2020
International Conference on Industrial and Applied Mathematics, Valencia, Spain	July 2019

"Learning PDE Models from Noisy Spatiotemporal Data"

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

"Parameter Estimation and Uncertainty Quantification in the Presence of Numerical Error"

NCSU Tutorial Workshop on Parameter Estimation for Biological Models, Raleigh, NC	July 2019
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"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

"Modeling 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	June, 2020
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"From Homework to Home Work"

Interviewed on my virtual teaching experience during COVID-19 for the Against the Grain blog	May, 2020
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Outreach and Pedagogical Presentations (cont.)

- “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

- e-Society of Mathematical Biology (SMB) Annual Meetings 2020**
Served on the Organizing Committee and coordinated the mentoring program and
scheduling for a virtual conference, held virtually August 2020
- Topological and Network Analyses for Data** (with Veronica Ciocanel)
Minisymposium Organizer at SMB annual Meetings, held Virtually August 2020
- Leveraging Machine Learning for Discovery of Mathematical Models in Biology**
(with John Lagergren and Kevin Flores) Minisymposium Organizer at SIAM Conference
on the Mathematics of Data Science, held Virtually June 2020
- 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*, *Nature Computational Science*, *PLOS One*
- Boulder Mental Health Partners: Computer and Mathematics Tutor June 2017 - July 2018