John T. Nardini

Assistant Professor
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BioMathNard

Academic appointments

The College of New Jersey, Ewing, NJ
Assistant Professor of Mathematics 2021-present

N. C. State University, Raleigh, NC
Postdoctoral Scholar 2018-2021

Statistical and Applied Mathematical Science Institute (SAMSI), Durham, NC
Postdoctoral Scholar (Joint) 2018-2020

Education

University of Colorado Boulder, CO
Ph.D., Applied Mathematics 2018
Dissertation Title: PDE Models of Collective Migration During Wound Healing
Adviser: David M. Bortz
Certificate in Interdisciplinary Quantitative Biology

N.C. State University, Raleigh, NC
B.S., Mathematics 2013

Research Interests

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

Grants and Awards

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 undergraduate co-author, †denotes equal contribution)

17. A. Malik, K. Nguyen, **J. Nardini**, K. Flores, C. Krona, S. Nedlander. Mathematical Modeling of Multicellular Tumor Spheroids Quantifies Inter-Patient and Inter-Tumor Heterogeneity. *NPJ Systems Biology & Applications* 11 (20) 2025 DOI: 10.1038/s41540-025-00492-3

16. **J. Nardini**. Forecasting and predicting agent-based model data with biologically-informed neural networks. *Bulletin of Mathematical Biology* 86 (130) 2024. DOI: 10.1007/s11538-024-01357-2.

15. K. Nguyen, C. Jameson, S. Baldwin, **J. Nardini**, R. Smith, J. Haugh, K. Flores. Quantifying fluidization patterns in mesenchymal cell populations using topological data analysis and agent-base modeling. *Mathematical Biosciences* 370 April 2024. DOI: 10.1016/j.mbs.2024.109158.

14. **J. Nardini**, C. Pugh*, H. Byrne. Statistical and topological summaries aid disease detection for segmented retinal vascular images. *Microcirculation* 30 (4) 2023. DOI: 10.1111/micc.12799.

13. **J. Nardini**, B. Stolz, H. Harrington, K. Flores, H. Byrne. Topological data analysis distinguishes parameter regimes in the Anderson-Chaplain model of angiogenesis. *PLoS Computational Biology* 17 (6) 2021. DOI: 10.1371/journal.pcbi.1009094.

12. **J. Nardini**, R. Baker, M. Simpson, K. Flores. Learning differential equation models from stochastic agent-based model simulations. *Journal of the Royal Society Interface* 18 (176) 2021. DOI: 10.1098/rsif.2020.0987.

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 under review

1. M.V. Ciocanel†, **J. Nardini**†, K. Flores, E. Rutter, S. Sindi, A. Volkening. Enhancing generalizability of model discovery across parameter space with multi-experiment equation learning (ME-EQL). arXiv 2506.08916.

2. E. Rohr*, **J. Nardini**. A novel sensitivity analysis method for agent-based models stratifies in-silico tumor spheroid simulations. arXiv 2506.00168

3. A. Wenzel, P. Haughey, K. Nguyen, **J. Nardini**, J. Haugh, K. Flores. Topologically-based parameter inference for agent-based model selection from spatiotemporal cellular data. bioRxiv 2025.06. 13.659586.

Pedagogical Publications

Book chapters (Not peer-reviewed)

1. **J. Nardini**. Trusting Students with Flexible Deadlines, pp. 88 - 96. In Practice and Policies: Advocating for Students of Color in Mathematics, P. E. Harris and A. Winger, independently published, 2021.

Teaching Experience

Course Instructor at TCNJ

Calculus A, MAT 127	6 semesters
Differential Equations, MAT 326	Fall 2024, Spring 2025, Fall 2025
Computational Mathematics, MAT 341	Fall 2023, Fall 2025
Data Mining & Predictive Modeling, STA/CSC 307	Spring 2024
Linear Algebra: Theory and Applications, MAT 205	Spring 2022

Course Instructor at NC State

Calculus for Life and Management Sciences A, MA 131	Fall 2019
Foundations of Advanced Mathematics, MA 225	Spring 2020, Fall 2020
Applied Differential Equations, MA 341	Spring 2021

Course Instructor at CU Boulder

Calculus I for Engineers, APPM 1350 — Summer 2017

Peer Scholar Groups

AMS Project NExT — 2020-21
Professional development program incorporating inclusive teaching methods into math classrooms.

TRESTLE Faculty Learning Community on metacognition — Spring 2017
Met weekly with group of scholars to discuss methods to promote metacognition in the classroom.

Mentoring Experience

Undergraduate Research

Antonio Madrigal — 2024-present
"Continuous and discrete models of tumor growth"

Vijay Manchiraju — 2024-2025
"Speeding up BINN model training"

Eddie Rohr — 2023-2024
"Computational summaries of tumor spheroids"

Alexa Karamanoogian — 2022-2024
"Mathematical models of enyzme kinetics"

Charlie Pugh — 2021-2022
"Applying TDA to Retinal Vasculature Segmentations"

Allison Duprey, Fanuel Sisay, Natasha Stewart, and Yangxinyu Xie — Summer 2019
"Sampling for Equation Learning Methods"

Graduate Research

Carter Jameson — 2020 - 2021
"Using Topology and Machine Learning to Aid Parameter Estimation of Cell Microscopy Models"

Mike Ackermann, Jorge Arroyo Esquivel, Jake Cherry, Jimi Kim, Ruby Kim, Natalie Meacham — Summer 2021
"Learning Equations from Stochastic Agent-based Model Simulations"

Invited Talks

"Forecasting agent-based model data with biologically-informed neural networks"
NJIT Mathematical Biology Seminar, Newark, NJ — November 2023

Seminar of Quantitative Modeling in Biology at UC Riverside, held virtually — February 2024
Society for Mathematical Biology Annual Meetings, Seoul, South Korea — July 2024
TCNJ School of Science Colloquium, Ewing, NJ — September 2024
BIRS workshop on Mechanistic Learning in Oncology, Banff, Canada — January 2025
Society for Mathematical Biology Annual Meetings, Edmonton, Canada — July 2025

"Statistical and Topological Summaries Aid Disease Detection for Segmented Retinal Vascular Images"
Society for Mathematical Biology Annual Meetings, Columbus, OH — July 2023
SIAM Conference on the Life Sciences, Pittsburgh, PA — July 2022

"Workshop on Data-driven Mathematical Modeling"
SIAM Conference on the Life Sciences, Pittsburgh, PA — July 2022

"Data-driven modeling for noisy biological data and agent-based Models"
U. Florida Systems Medicine Seminar, held virtually — April 2021

"Topology Discriminates Models of Angiogenesis"
Maathfest, Philadelphia, PA — August 2022
TCNJ School of Science Colloquium, Ewing NJ — November 2021
Society for Mathematical Biology Annual Meetings, held virtually — July 2021
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

"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

Conference Organizing

Data-Driven Mathematical Modeling (with Kevin Flores and Erica Rutter)
Minisymposium Organizer at SMB Annual Meetings, Columbus, OH — July 2023

Combining Topological, Data-Driven, and Modeling Perspectives for Complex Biological Systems (with Veronica Ciocanel and Alexandria Volkening)
Minisymposium Organizer at SIAM conference on the Life Sciences, Pittsburgh, PA — July 2022

Combining Modeling and Inference in Cell Biology (with Veronica Ciocanel)

Minisymposium Organizer at SMB annual Meetings, held Virtually — July 2021

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

TCNJ Service

TCNJ School of Science Interdisciplinary Research Committee — 2024 - present

TCNJ Applied Mathematics Committee — 2021 - present

TCNJ Applied Mathematics Committee (chair) — 2023 - present

TCNJ Mathematics and Statistics Department Colloquium organizer — 2021 - 2024

TCNJ Mathematics and Statistics Bachelor of Arts Commmittee — 2022

TCNJ Mathematics and Statistics Mid-level Curriculum Commmittee — 2022

Service to the field

Associate Editor for *Mathematical Biosciences* — 2024 - present

Reviewer for: *Bulletin of Mathematical Biology, Journal of Theoretical Biology, Mathematical Biosciences Mathematical Biosciences and Engineering, Inverse Problems, Nature Computational Science, Computer Physics Communications, Engineering Computations, PLOS One, Heliyon, SIAM Undergraduate Research Online.*

Guest editor for *Bulletin of Mathematical Biology*'s special issue on "Data-driven mathematical modeling." — 2022-2023

SMB Methods for Biological Modeling subgroup co-chair — 2019 - present

Participated in professional development panels for:
- SAMSI undergradate workshop on Methods of Uncertainty — February 2019
- SAMSI undergradate workshop on Precision Medicine — October 2018