Zixuan Cang

Curriculum Vitae

Assistant Professor
Department of Mathematics
North Carolina State University
Raleigh, NC 27607

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https://zcang.math.ncsu.edu/

EDUCATION

PhD, Applied Mathematics 2013–2018
Michigan State University, East Lansing, MI.
BS, Pure and Applied Mathematics 2009–2013
Xiamen University, Xiamen, China

RESEARCH INTERESTS

Mathematical Biology; Optimal Transport; Applied Topology; Scientific Computing.

EMPLOYMENT

North Carolina State University, *Raleigh, NC.*
Department of Mathematics
Assistant Professor Aug 2021–Present
University of California, Irvine, *Irvine, CA.*
Department of Mathematics / The NSF-Simons Center for Multiscale Cell Fate Research
Postdoctoral Scholar Aug 2018–Jun 2021

OTHER AFFILIATIONS

National Institute for Theory and Mathematics in Biology (NITMB),
Northwestern University and the University of Chicago
Affiliated Faculty Oct 2025–Present

The Center for Research in Scientific Computation, *NC State University*
Affiliated Faculty Aug 2021–Present

PUBLICATIONS

(* co-first author)

Preprints

36. Yaqi Wu, Jingfeng Wang, Yanxiang Zhao, and **Zixuan Cang**. RAFT-UP: Robust alignment for spatial transcriptomics using partial overlapping. *arXiv preprint arXiv:2603.18249*, 2026
35. **Zixuan Cang**, Jingfeng Wang, Xiaoqi Wei, and Yanxiang Zhao. Synchronization of unbalanced dynamical optimal transport across multiple spaces. *arXiv preprint arXiv:2602.18725*, 2026

Published

34. Perry Z Beamer and **Zixuan Cang**. Multiscale domain identification for spatial transcriptomics via persistent homology. *Cell Reports Methods*, 2026
33. Eric Bourgain-Chang, Xiangyu Kuang, **Zixuan Cang**, and Qing Nie. Reconstructing single-cell resolution from spatial transcriptomics with CellRefiner. *Nature Communications*, 17:3304, 2026
32. Xiaoqi Wei, Xuhang Dai, Yaqi Wu, Yanxiang Zhao, Yingkai Zhang, and **Zixuan Cang**. OTMol: Robust molecular structure comparison via optimal transport. *Journal of Chemical Information and Modeling*, 65(20):11013–11028, 2025

31. **Zixuan Cang**, Yaqi Wu, and Yanxiang Zhao. Supervised Gromov-Wasserstein optimal transport with metric-preserving constraints. *SIAM Journal on Mathematics of Data Science*, 7(1):301–328, 2025

30. **Zixuan Cang** and Yanxiang Zhao. Synchronized optimal transport for joint modeling of dynamics across multiple spaces. *SIAM Journal on Applied Mathematics*, 85(1):341–365, 2025

29. Michael V Zaragoza, Thuy-Anh Bui, Halida P Widyastuti, Mehrsa Mehrabi, **Zixuan Cang**, Yutong Sha, Anna Grosberg, and Qing Nie. Lmna-related dilated cardiomyopathy: Single-cell transcriptomics during patient-derived ipsc differentiation support cell type and lineage-specific dysregulation of gene expression and development for cardiomyocytes and epicardium-derived cells with lamin a/c haploinsufficiency. *Cells*, 13(17):1479, 2024

28. Jiahui Chen, Yongjia Xu, Xin Yang, **Zixuan Cang**, Weihua Geng, and Guo-Wei Wei. Poisson-boltzmann based machine learning (pbml) model for electrostatic analysis. *Biophysical Journal*, 2024

27. Tram Huynh and **Zixuan Cang**. Topological and geometric analysis of cell states in single-cell transcriptomic data. *Briefings in Bioinformatics*, 25(3):bbae176, 2024

26. Kathryn Dover, **Zixuan Cang**, Anna Ma, Qing Nie, and Roman Vershynin. Avida: An alternating method for visualizing and integrating data. *Journal of Computational Science*, page 101998, 2023

25. **Zixuan Cang**, Yanxiang Zhao, Axel A. Almet, Adam Stabell, Raul Ramos, Maksim V. Plikus, Scott X. Atwood, and Qing Nie. Screening cell-cell communication in spatial transcriptomics via collective optimal transport. *Nature Methods*, 20:218–228, 2023

24. **Zixuan Cang**, Qing Nie, and Yanxiang Zhao. Supervised optimal transport. *SIAM Journal on Applied Mathematics*, 82(5):1851–1877, 2022

23. Honglei Ren, Benjamin L Walker, **Zixuan Cang**, and Qing Nie. Identifying multicellular spatiotemporal organization of cells with spaceflow. *Nature Communications*, 13(1):4076, 2022

22. Benjamin L Walker, **Zixuan Cang**, Honglei Ren, Eric Bourgain-Chang, and Qing Nie. Deciphering tissue structure and function using spatial transcriptomics. *Communications Biology*, 5(1):220, Mar 2022

21. David Tatarakis, **Zixuan Cang**, Xiaojun Wu, Praveer P Sharma, Matthew Karikomi, Adam L MacLean, Qing Nie, and Thomas F Schilling. Single-cell transcriptomic analysis of zebrafish cranial neural crest reveals spatiotemporal regulation of lineage decisions during development. *Cell reports*, 37(12):110140, 2021

20. **Zixuan Cang**, Xinyi Ning, Annika Nie, Min Xu, and Jing Zhang. Scan-it: Domain segmentation of spatial transcriptomics images by graph neural network. In *British Machine Vision Conference*, 2021

19. Mehrsa Mehrabi, Tessa A Morris, **Zixuan Cang**, Cecilia HH Nguyen, Yutong Sha, Mira N Asad, Nyree Khachikyan, Taylor L Greene, Danielle M Becker, Qing Nie, Michael V. Zaragoza, and Anna Grosberg. A study of gene expression, structure, and contractility of ipsc-derived cardiac myocytes from a family with heart disease due to lmna mutation. *Annals of Biomedical Engineering*, pages 1–16, 2021

18. Qing Zhu, Yuzhe Du, Yoshiko Nomura, Rong Gao, **Zixuan Cang**, Guo-Wei Wei, Dalia Gordon, Michael Gurevitz, James Groome, and Ke Dong. Charge substitutions at the voltage-sensing module of domain iii enhance actions of site-3 and site-4 toxins on an insect sodium channel. *Insect Biochemistry and Molecular Biology*, page 103625, 2021

17. Axel A. Almet, **Zixuan Cang**, Suoqin Jin, and Qing Nie. The landscape of cell–cell communication through single-cell transcriptomics. *Current Opinion in Systems Biology*, 26:12–23, 2021

16. Floyd Maseda, **Zixuan Cang**, and Qing Nie. Deepsc: A deep learning-based map connecting single-cell transcriptomics and spatial imaging data. *Frontiers in Genetics*, 12:348, 2021

15. **Zixuan Cang***, Yangyang Wang*, Qixuan Wang, Ken W. Y. Cho, William Holmes, and Qing Nie. A multiscale model via single-cell transcriptomics reveals robust patterning mechanisms during early mammalian embryo development. *PLOS Computational Biology*, 17(3):1–20, 03 2021

14. **Zixuan Cang**, Elizabeth Munch, and Guo-Wei Wei. Evolutionary homology on coupled dynami-

cal systems with applications to protein flexibility analysis. *Journal of Applied and Computational Topology*, pages 1–27, 2020

13. Ruiqiong Guo, **Zixuan Cang**, Jiaqi Yao, Miyeon Kim, Erin Deans, Guowei Wei, Seung gu Kang, and Heedeok Hong. Structural cavities are critical to balancing stability and activity of a membrane-integral enzyme. *Proceedings of the National Academy of Sciences*, 2020
12. **Zixuan Cang** and Qing Nie. Inferring spatial and signaling relationships between cells from single cell transcriptomic data. *Nature Communications*, 11(1):1–13, 2020
11. **Zixuan Cang** and Guo-Wei Wei. Persistent cohomology for data with multicomponent heterogeneous information. *SIAM Journal on Mathematics of Data Science*, 2(2):396–418, 2020
10. Daniel Haensel, Suoqin Jin, Peng Sun, Rachel Cinco, Morgan Dragan, Quy Nguyen, **Zixuan Cang**, Yanwen Gong, Remy Vu, Adam L. MacLean, Kai Kessenbrock, Enrico Gratton, Qing Nie, and Xing Dai. Defining epidermal basal cell states during skin homeostasis and wound healing using single-cell transcriptomics. *Cell Reports*, 30(11):3932–3947.e6, Mar 2020
9. Duc Duy Nguyen, **Zixuan Cang**, and Guo-Wei Wei. A review of mathematical representations of biomolecular data. *Physical Chemistry Chemical Physics*, 22(8):4343–4367, 2020
8. Menglun Wang, **Zixuan Cang**, and Guo-Wei Wei. A topology-based network tree for the prediction of protein–protein binding affinity changes following mutation. *Nature Machine Intelligence*, 2(2):116–123, 2020
7. Duc Duy Nguyen, **Zixuan Cang**, Kedi Wu, Menglun Wang, Yin Cao, and Guo-Wei Wei. Mathematical deep learning for pose and binding affinity prediction and ranking in d3r grand challenges. *Journal of Computer-Aided Molecular Design*, Aug 2018
6. Rundong Zhao, **Zixuan Cang**, Yiying Tong, and Guo-Wei Wei. Protein pocket detection via convex hull surface evolution and associated Reeb graph. *Bioinformatics*, 34(17):i830–i837, 2018
5. **Zixuan Cang**, Lin Mu, and Guo-Wei Wei. Representability of algebraic topology for biomolecules in machine learning based scoring and virtual screening. *PLoS Computational Biology*, 14(1):e1005929, 2018
4. **Zixuan Cang** and Guo-Wei Wei. Topologynet: Topology based deep convolutional and multi-task neural networks for biomolecular property predictions. *PLoS Computational Biology*, 13(7):e1005690, 2017
3. **Zixuan Cang** and Guo-Wei Wei. Integration of element specific persistent homology and machine learning for protein-ligand binding affinity prediction. *International Journal for Numerical Methods in Biomedical Engineering*, page e2914, 2017
2. **Zixuan Cang** and Guo-Wei Wei. Analysis and prediction of protein folding energy changes upon mutation by element specific persistent homology. *Bioinformatics*, 33(22):3549–3557, 2017
1. **Zixuan Cang**, Lin Mu, Kedi Wu, Kristopher Opron, Kelin Xia, and Guo-Wei Wei. A topological approach for protein classification. *Molecular Based Mathematical Biology*, 3(1):140–162, 2015

GRANTS

Goodnight Early Career Innovator Award ($66,000) 6/2026 - 5/2029
Role: PI

NC State Cluster Research Grant ($50,000) 1/1/2025 - 6/30/2027
Role: PI

NIH R01GM152494 ($1,372,616) 9/20/2024 - 6/30/2028
Role: MPI
Title: Development of tools for analyzing cell-cell communication using spatial transcriptomic data

NC State Seed Grant ($15,000) 10/15/2024 - 8/15/2025
Role: PI

Title: Data-driven causal discovery of cell-cell communication impacts from transcriptomic data: recovering signaling mechanisms of lung development

NC State Seed Grant ($15,000) 10/15/2024 - 8/15/2025
Role: PI
Title: Innovative computational methods to decipher cell cycle dynamics from single cell transcriptomes of easily cultured, yet complex eukaryotes

NC State Seed Grant ($25,000) 10/15/2024 - 8/15/2025
Role: Co-PI
Title: Development of DRIFT Therapy to Boost Pulmonary Drug Delivery

NSF DMS-2151934 ($374,381) 9/01/2022 - 8/31/2025
Role: PI
Title: Topological and Geometric Modeling and Computation of Structures and Functions in Single-Cell Omics Data

PATENTS

- System and methods for electrostatic analysis with machine learning model
  U.S. Patent Application No. 17/637,440,
  Authors: Guowei Wei, Zixuan Cang, Jiahui Chen, Weihua Geng

HONORS and AWARDS

7. (2025) Goodnight Early Career Innovator Award, NC State
6. (2025) John Griggs Faculty Award for Outstanding Research, Department of Mathematics, NC State
5. (2025) ScholarGPS Highly Ranked Scholars (#4 in Transcriptomics technologies, #5 in Single-cell transcriptomics, prior five years)
4. (2019) ICCM Best Paper Award, International Consortium of Chinese Mathematics
3. (2018) Douglas A. Spragg Endowed Fellowship in Mathematics, Michigan State University
2. (2018) Dr. Paul and Wilma Dressel Endowed Scholarship, Michigan State University
1. (2017) Dissertation Completion Fellowship, Michigan State University

CONFERENCES and PRESENTATIONS

Conferences organized

7. Conference "Systems Biology of Single Cells", University of California, Irvine, Irvine, California, May 8–9, 2025 (co-organized with Adam MacLean and Katie Galloway)
6. Mini-symposium "Topological Data Analysis in Biosciences" at SIAM-SEAS Conference, Knoxville, Tennessee, Mar 21–23, 2025 (co-organized with Jiahui Chen)
5. Mini-symposium "Modeling and Computation of Optimal Transport with Applications in Biology" at the 2024 SIAM Annual Meeting Online, Jul 18–20, 2024 (co-organized with Yanxiang Zhao)
4. Mini-symposium "Optimal Transport and Mean Field Games with Applications and Computations" at The 13th AIMS Conference on Dynamical Systems, Differential Equations and Applications, Wilmington, North Carolina, May 31–Jun 4, 2023 (co-organized with Wuchen Li and Yanxiang Zhao)

3. Mini-symposium "Molecular Biosciences: Modeling for Sequence and Structure-Based Molecular Analysis" at the 2022 SIAM Conference on the Life Sciences, Pittsburgh, Pennsylvania, Jul 11–14, 2022 (co-organized with Jiahui Chen)

2. Workshop "Optimal Transport: Theory, Computation, and Biology", University of California, Irvine, Jun 3–4, 2022 (co-organized with Anna Ma and Wuchen Li)

1. Mini-symposium "Topological data learning" at the 2020 SIAM Conference on Mathematics of Data Science, Online virtual meeting, Jun 25, 2020 (co-organized with Kelin Xia)

Invited talks

34. (lecture series) Barrett Memorial Lectures of Mathematics – Mathematical Foundations for Computational and Data-Driven Scientific Discovery, University of Tennessee Knoxville, May 18–20, 2026
33. (special session) AMS Southeastern Sectional Meeting, Special session: Recent advances in Molecular based Computational and Mathematical Bioscience, Georgia Southern University-Armstrong Campus, Savannah, GA, Mar 28–29, 2026
32. (lecture) Helen Barton Lecture, Department of Mathematics and Statistics, University of North Carolina Greensboro, Jan 28, 2026
31. (symposium) International Symposium – Understanding Cells in Context: A Focus on Spatial Biology, Institute for Research in Immunology and Cancer (IRIC), Université de Montréal, Canada, Oct 24, 2025
30. (colloquium) Colloquium, Department of Computational Mathematics, Science, and Engineering, Michigan State University, Oct 13, 2025
29. (mini-symposium) SIAM Central States Section Meeting, Mini-symposium: Mathematical Modeling in Biosciences, University of Arkansas, Oct 11–12, 2025
28. (seminar) Midwest Mathematical Biology Seminar, Apr 4, 2025
27. (mini-symposium) SIAM SEAS Conference, Mini-symposium: Recent advances in mathematical biology – Modeling life across scales, Knoxville, Tennessee, Mar 21–23, 2025
26. (seminar) Seminar, Simons Center for Computational Physical Chemistry (SCCPC), New York University, Mar 17, 2025
25. (mini-symposium) SIAM Conference on Mathematics of Data Science, Mini-symposium: Manifold learning, trajectory inference, and applications in biology, Atlanta, Georgia, Oct 21–25, 2024
24. (mini-symposium) SIAM Conference on the Life Sciences, Mini-symposium: Data-driven modeling and learning methods in biology and medicine, Portland, Oregon, Jun 10–13, 2024
23. (seminar) Digital Science Seminar, Boston Children's Hospital, Harvard Medical School, Jan 23, 2024
22. (seminar) Statistics Seminar, Department of Mathematical Sciences, Indiana University-Purdue University Indianapolis, Nov 14, 2023
21. (workshop) Workshop on Spatial and Time-Resolved Single-Cell Transcriptomics Analysis, Michigan State University, Nov 12–13, 2023
20. (mini-symposium) ICIAM, Mini-symposium: Applications of machine learning to analyzing time-series and imaging data, Aug 22, 2023
19. (workshop) Spatial Transcriptomics Workshop, German Association for Medical Informatics, Biometry and Epidemiology, May 9, 2023
18. (seminar) Seminar, Department of Statistics, North Carolina State University, Apr 21, 2023
17. (seminar) Seminar, Duke Single Cell Initiative, Duke University, Mar 27, 2023
16. (colloquium) Applied Mathematics Colloquium, Department of Mathematics, University of North Carolina Chapel Hill, Mar 8, 2023
15. (seminar) Weekly seminar of SCORCH Consortium (Single Cell Opioid Responses in the Context of HIV), Feb 16, 2023
14. (Colloquium) Applied Mathematics, Department of Mathematics and Statistics, University of North Carolina Charlotte, Nov 4, 2022

13. (seminar) Applied Mathematics Seminar, Department of Mathematics, University of Georgia, Sep 6, 2022
12. (mini-symposium) 2022 SIAM Conference on the Life Sciences (LS22), Mini-symposium: Molecular Biosciences: Modeling for Sequence- and Structure-Based Molecular Analysis, Pittsburgh, Pennsylvania, Jul 11–14, 2022
11. (seminar) Interdisciplinary Center for Quantitative Modeling in Biology Seminar, University of California Riverside, May 10, 2022
10. (seminar) Applied Mathematics Seminar, Department of Mathematics, University of Georgia, Apr 12, 2022
9. (seminar) MINDS (Mathematical Institute for Data Science) Seminar Series, Pohang University of Science and Technology, Mar 22, 2022
8. (seminar) Applied Mathematics Seminar, Department of Mathematics, The George Washington University, Oct 29, 2021
7. (symposium) Geometric and Topological Information in Data Analysis, Joint Statistical Meeting (JSM), Aug 8, 2021
6. (seminar) Interdisciplinary Center for Quantitative Modeling in Biology Seminar, University of California Riverside, Jan 19, 2021
5. (Colloquium) Department of Mathematics, University of California Irvine, Jan 12, 2021
4. (mini-symposium) SIAM Conference on Mathematics of Data Science (MDS20), Online virtual meeting, Jun 26, 2020
3. (special session) Special Session on Mathematical Modeling in Developmental Biology, AMS Fall Western Sectional Meeting, University of California, Riverside, California, Nov 9–10, 2019
2. (workshop) Structure in the Micro-world, Ohio State University, Columbus, Ohio, May 28–31, 2019
1. (mini-symposium) The 3rd Annual Meeting of SIAM Central States Section, Colorado State University, Fort Collins, CO, Sep 29–Oct 1, 2017

TEACHING EXPERIENCE

MTH124, Survey of Calculus I — Michigan State University
Instructor — 2014 Summer/2014 Fall/2015 Spring/2015 Fall

MTH234, Multivariable Calculus — Michigan State University
Recitation TA — 2013 Fall/2014 Spring/2016 Spring

MATH2D, Multivariable Calculus I — University of California Irvine
Instructor — 2020 Fall

MATH3A, Intro Linear Algebra — University of California Irvine
Instructor — 2021 Winter/2021 Spring

MA131H, Calculus for Life and Management Sciences A — North Carolina State University
Instructor — 2021 Fall

MA241, Calculus II — North Carolina State University
Instructor — 2025 Fall

MA305, Introductory Linear Algebra and Matrices — North Carolina State University
Instructor — 2022 Spring/2023 Spring/2024 Fall

MA771 Biomathematics I, Differential Equations in Biology — North Carolina State University
Instructor — 2022 Fall/2023 Fall

MA797, Topological Data Analysis for Biology — North Carolina State University
Instructor — 2024 Spring

MA797, Computational Optimal Transport with Applications in Biology

North Carolina State University

Instructor 2026 Spring

MTH994: Mathematics-Assisted AI and AI-inspired Mathematics

Michigan State University

Guest Lectures (two lectures on Optimal Transport) 2025 Fall

MENTORING

Ph.D. Students (NC State)

Zhuyang Lin (Bioinformatics) 2024 Fall–Present
Tanner Byer (Biomath) 2024 Fall–Present
Avery Paulsen (Biomath) 2024 Fall–Present
Ian Livengood (Mathematics) 2024 Spring–Present
Perry Beamer (Biomath) 2023 Fall–Present

Postdoctoral Scholars

Xiaoqi Wei 2025 Spring–Present
Jingfeng Wang 2024 Fall–Present

Undergraduate research

North Carolina State University

Leah Valentiner June 2024–June 2025
Denis Selyuzhitsky June 2024–June 2025
Andrew Soma June 2024–June 2025
Mingye Wang June 2024–June 2025
Tram Huynh July 2022–May 2024

Michigan State University (With Prof. Guo-Wei Wei)

Tianwei Yue 2017 Spring
Kollin David Poindexter 2017 Spring/2017 Summer
Yuecheng Li 2017 Spring
Fatme Hourani 2017 Summer

OUTREACH

NCSU Catalyst program

STEM research experience for high school students

Mathiew Lewis 2022 Summer
Lillian Hall 2022 Summer
Dylan Nicholas Dorris 2023 Summer
Evelin Elizabeth Golovashkina 2023 Summer

PROFESSIONAL SERVICES

Journal Editor

Editorial Advisory Board, Computational and Mathematical Biophysics 2024 -
Associate Editor, Data Analytics and Topology 2024 -

Journal Referee

- Nature Methods
- Nature Machine Intelligence
- Cell Systems
- Nature Communications
- Genome Research
- Genome Biology
- Journal of the American Statistical Association
- Nucleic Acids Research
- PLOS Computational Biology

- PLOS Biology
- Briefings in Bioinformatics
- Cell Reports Methods
- Journal of Chemical Information and Modeling
- Journal of Machine Learning Research
- IEEE Transactions on Pattern Analysis and Machine Intelligence
- BMC Bioinformatics
- IEEE/ACM Trans. on Computational Biology and Bioinformatics
- ACS Omega
- La Matematica
- Journal of Applied and Computational Topology
- Mathematical Biosciences and Engineering
- International J. for Numerical Methods in Biomedical Engineering
- Communications in Information & Systems
- Computational and Mathematical Biophysics

Grant Reviewer

- NSF DMS panel (2 panels in 2023)
- UKRI scientific reviewer (June 2025)
- NIH study session (1 panel in 2026)
- Swiss National Science Foundation external reviewer (April 2026)
- NITMB training grant panel (June 2026)