

Zixuan Cang

Curriculum Vitae

Department of Mathematics
University of California, Irvine
Irvine, CA 92617

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EDUCATION

PhD, Applied mathematics	2013-2018
<i>Michigan State University, East Lansing, MI.</i>	
BS, Pure and applied mathematics	2009-2013
<i>Xiamen University, Xiamen, China</i>	

RESEARCH INTERESTS

Mathematical Biology/Biophysics; Topological Data Analysis; Numerical PDE; Machine Learning/Deep Learning; and Parallel/GPU Computing.

RESEARCH EXPERIENCE

University of California, Irvine, Irvine, CA.

Department of Mathematics

Visiting Assistant Professor

Jul 2020 - Present

Postdoctoral Scholar

Aug 2018 - Jun 2020

The NSF-Simons Center for Multiscale Cell Fate Research

Postdoctoral Fellow

Aug 2018 - Present

PUBLICATIONS

(* co-first author)

Published/Accepted

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
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
3. **Zixuan Cang** and Guo-Wei Wei. Integration of element specific persis-

tent homology and machine learning for protein-ligand binding affinity prediction. *International Journal for Numerical Methods in Biomedical Engineering*, page e2914, 2017

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
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
6. Rundong Zhao, **Cang, Zixuan**, Yiyong Tong, and Guo-Wei Wei. Protein pocket detection via convex hull surface evolution and associated Reeb graph. *Bioinformatics*, 34(17):i830–i837, 2018
7. Duc Duy Nguyen, **Cang, Zixuan**, 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
8. Menglun Wang, **Cang, Zixuan**, 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
9. Duc Duy Nguyen, **Cang, Zixuan**, and Guo-Wei Wei. A review of mathematical representations of biomolecular data. *Physical Chemistry Chemical Physics*, 22(8):4343–4367, 2020
10. Daniel Haensel, Suoqin Jin, Peng Sun, Rachel Cinco, Morgan Dragan, Quy Nguyen, **Cang, Zixuan**, 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
11. **Cang, Zixuan** and Guo-Wei Wei. Persistent cohomology for data with multicomponent heterogeneous information. *SIAM Journal on Mathematics of Data Science*, 2(2):396–418, 2020
12. **Cang, Zixuan** and Qing Nie. Inferring spatial and signaling relationships between cells from single cell transcriptomic data. *Nature Communications*, 11(1):1–13, 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
14. **Cang, Zixuan**, Elizabeth Munch, and Guo-Wei Wei. Evolutionary homology on coupled dynamical systems with applications to protein flexibility analysis. *Journal of Applied and Computational Topology*, pages 1–27, 2020

In revision/Revision submitted

15. Qing Zhu, Yuzhe Du, Yoshiko Nomura, Rong Gao, **Cang, Zixuan**, Guo-Wei Wei, Dalia Gordon, Michael Gurevitz, James Groome, and Ke Dong. Charge substitutions at the voltage-sensing module of domain iii enhance the effects of α and β -toxins on an insect sodium channel. *In revision, Journal of Molecular Biology*, 2020
16. **Cang***, **Zixuan**, Yangyang Wang*, Ken Cho, William Holmes, and Qing Nie. Spatial-temporal trajectory of early embryo development by data-informed multiscale model. *PLoS Computational Biology*, *In revision*, 2020
17. Mehrsa Mehrabi, Tessa A. Morris, **Cang, Zixuan**, Cecilia H. H. Nguyen, Yutong Sha, Mira N. Asad, Nyree Khachikyan, Taylor L. Greene, Danielle M. Becker, Qing Nie, Michael V. Zaragoza, and Anna Grosberg. In vitro modeling of variable heart diseases due to lmna mutation via patient ipsc-derived cardiomyocytes. *Submitted*, 2020

PATENTS

System and methods for machine learning for drug design and discovery
 U.S. Patent Application No. 16/372,239
 Authors: Wei, Guowei, Duc Nguyen, and Zixuan Cang

GRANTS SUBMITTED

Burroughs Welcome Fund (pending)
 (\$500,000.00) 09/01/2021-08/31/2026
 Role: PI

Title: Topology, geometry, and deep learning powered cell fate research from molecules to cells with application to drug design

National Science Foundation (pending)

(\$109,521.00) 04/01/2021 - 03/31/2026

Role: PI

Title: Topological and geometric modeling and computation of structures and functions in single-cell omics data

Chan Zuckerberg Initiative (pending)

(\$99,267.00 subcontract) 01/01/2021 - 12/31/2021

Role: Co-PI (PI: Prof. Guowei Wei)

Title: Topological featurization of molecular structures for machine learning

HONORS and AWARDS

(2019) Best Paper Award (\$5K prize), International Consortium of Chinese Mathematics

(2018) Douglas A. Spragg Endowed Fellowship in Mathematics, Michigan State University

(2018) Dr. Paul and Wilma Dressel Endowed Scholarship, Michigan State University

(2017) Dissertation Completion Fellowship, Michigan State University

CONFERENCES and PRESENTATIONS

20. (minisymposium organizer/speaker) SIAM Conference on Mathematics of Data Science (MDS20), Online virtual meeting, 2020.6.26
19. (invited speaker) Special Session on Mathematical Modeling in Developmental Biology, AMS Fall Western Sectional Meeting, University of California, Riverside, California, 2019.11.9-2019.11.10
18. (invited speaker) Applied Math Seminar, Colorado State University, Fort Collins, Colorado, 2019.10.30
17. (poster) 2nd Annual Symposium on Multiscale Cell Fate, University of California, Irvine, California, 2019.10.28-2019.10.29
16. (invited speaker) Structure in the Micro-world, Ohio State University, Columbus, Ohio, 2019.5.28-2019.5.31
15. (invited speaker) NSF-CBMS Conference: Mathematical Molecular Bioscience and Biophysics, The University of Alabama, Tuscaloosa, Alabama, 2019.5.13-2019.5.17

14. (poster) 1st Annual Symposium on Multiscale Cell Fate, University of California, Irvine, California, 2018.10.1-2018.10.2
13. (participant) Workshop on the Mathematics of Drug Design/Discovery, The Fields Institute, Toronto, Canada, 2018.6.4-2018.6.8
12. (invited speaker) CCMA PDEs and Numerical Methods Seminar Series, Pennsylvania State University, University Park, Pennsylvania, 2018.3.21
11. (participant) D3R 2018 Workshop, University of California San Diego, San Diego, CA, 2018.2.22-2018.2.23
10. (invited speaker) The 3rd Annual Meeting of SIAM Central States Section, Colorado State University, Fort Collins, CO, 2017.9.29-2017.10.1
9. (invited participant) Topology of the Biomolecular World, American Institute of Mathematics, San Jose, California, 2017.7.24-2017.7.28
8. (poster) Topological, geometrical, and statistics techniques in biological data analysis, Mathematical Biosciences Institute, 2016.9.12-2016.9.16
7. (invited speaker) 2016 SIAM Conference on the Life Sciences (LS16), Westin Boston Waterfront, Boston, 2016.7.11-2016.7.14
6. (invited speaker) Workshop on Modeling and Analysis in Molecular Biology and Electrophysiology, Soochow University, China, 2016.6.16-2016.6.18
5. (poster) Modeling and Computation of Transmembrane Transport, Mathematical Biosciences Institute, 2015.11.16-2015.11.20
4. (invited participant) Geometric and Topological Modeling of Biomolecules, Mathematical Biosciences Institute, 2015.9.28-2015.10.02
3. (poster) IMA hot topic workshop on "Mathematics of Biological Charge Transport: Molecular and Beyond", IMA, Twin Cities, 2015.07.20-2015.07.24
2. (travel award) Winter school: Geometric PDEs and their approximations, Texas A&M, 2015.1.10-2015-1.16
1. (invited participant) Workshop on persistent homology for biosciences, East Lansing, 2014.10.18-2014.10.20

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
Undergraduate research mentoring (With Professor Guo-Wei Wei at MSU)	
Ms. Tianwei Yue	2017 Spring
Mr. Kollin David Poindexter	2017 Spring/2017 Summer
Mr. Yuecheng Li	2017 Spring
Ms. Fatme Hourani	2017 Summer

PROFESSIONAL SERVICES

Journal Reviewer

Journal of Chemical Information and Modeling, Genes, Entropy, Applied Sciences, BMC Bioinformatics, IEEE/ACM Transactions on Computational Biology and Bioinformatics, Algorithms, Computational and Mathematical Biophysics, International Journal for Numerical Methods in Biomedical Engineering, Communications in Information & Systems, PLOS ONE

REFERENCES

Professor Guo-Wei Wei (Ph.D. advisor)

Department of Mathematics, Michigan State University
Email: wei@math.msu.edu

Professor Qing Nie (Postdoc mentor)

Department of Mathematics, University of California Irvine
Email: qnie@math.uci.edu

Professor Gunnar Carlsson

Department of Mathematics, Stanford University
Email: Gunnar@math.stanford.edu

Professor Heedeok Hong

Department of Chemistry, Michigan State University
Email: honghd@msu.edu