

Dhananjay Bhaskar

CONTACT INFORMATION	<i>Email:</i> dhananjay.bhaskar@yale.edu <i>GitHub:</i> @dbhaskar92 <i>Citizenship:</i> Indian (Permanent Resident, Canada)	<i>Mobile:</i> (+1) 401-338-9829 <i>Website:</i> dhananjaybhaskar.com <i>ORCID:</i> 0000-0001-8068-3101
INTERESTS	Representation Learning, Graph ML, Geometric Deep Learning, Dynamical Systems, Agent-Based Models, Topological Data Analysis, Mathematical & Computational Biology	
APPOINTMENTS	Yale University , New Haven, CT, USA Postdoctoral Research Associate, Yale - Boehringer Ingelheim Fellow Advisor: Prof. Smita Krishnaswamy Brown University , Providence, RI, USA Visiting Scholar in Engineering	Jun 2021 - Present Jun 2021 - Apr 2023
EDUCATION	Brown University , Providence, RI, USA Ph.D. - Biomedical Engineering Sc.M. - Data Science Dissertation: Topological Data Analysis of Collective Motion Advisor: Prof. Ian Y. Wong University of British Columbia , Vancouver, BC, Canada M.Sc. - Institute of Applied Mathematics (Specialization in Mathematical Biology) Dissertation: Morphology-Based Cell Classification: Unsupervised Machine Learning Approach Advisor: Prof. Leah Edelstein-Keshet University of British Columbia , Vancouver, BC, Canada B.Sc. - Combined Major in Computer Science & Mathematics (with distinction)	May 2021 May 2017 May 2015
HONORS AND AWARDS	<ul style="list-style-type: none">DAAD AINeT Fellowship for Generative Models in Machine LearningYale - Boehringer Ingelheim Biomedical Data Science FellowshipBrown Data Science Initiative Seed GrantAMS MRC Collaborative Research Travel GrantE Paul Sorensen Graduate FellowshipFaculty of Science Graduate AwardThe Tenth q-bio Summer School ScholarshipInternational Tuition ScholarshipInternational Undergraduate Summer Research Award	2023 2021 - 2024 2020 2019 2017 2016 2016 2015 - 2016 2014
JOURNAL PUBLICATIONS	J9 Cell cycle controls long-range calcium signaling in the regenerating epidermis , Moore J. [*] , <u>Bhaskar, D.[*]</u> , Gao, F., Matte-Martone, C., Du, S., Lathrop, E., Ganesan, S., Shao, L., Norris, R., Sanz, N., Annusver, K., Kasper, M., Cox, A., Hendry, C., Rieck, B., Krishnaswamy, S., & Greco, V. <i>J Cell Biol</i> 222 (7), e202302095, 2023. J8 Transformer-based protein generation with regularized latent space optimization , Castro E., Godavarthi A., Rubinien J., Givechian K., <u>Bhaskar, D.[†]</u> , & Krishnaswamy, S. [†] <i>Nature Machine Intelligence</i> 4, 840-851, 2022.	

JOURNAL
PUBLICATIONS
(Contd.)

- J7 **Topological data analysis of collective and individual epithelial cells using persistent homology of loops**, Bhaskar, D., Zhang, W., & Wong, I. *Soft Matter* 17, 4653-4664, 2021.
- J6 **Analyzing collective motion with machine learning and topology**, Bhaskar, D., Manhart, A., Milzman, J., Nardini, J., Storey, K., Topaz, C., & Ziegelmeier, L. *Chaos* 29, 123125, 2019.
- J5 **Motility-limited aggregation of mammary epithelial cells into fractal-like clusters**, Leggett, S., Neronha, Z., Bhaskar, D., Sim, J., Perdikari, T., & Wong, I. *PNAS* 116 (35), 17298-17306, 2019.
- J4 **Breast cancer cells transition from mesenchymal to amoeboid migration in tunable 3D silk-collagen hydrogels**, Khoo, A., Valentin, T., Leggett, S., Bhaskar, D., Bye, E., Benmelech, S., Ip, B., & Wong, I. *ACS Biomaterials Science & Engineering* 5 (9), 4341-4354, 2019.
- J3 **3D printed self-adhesive PEGDA-PAA hydrogels as modular components for soft actuators and microfluidics**, Valentin, T., DuBois, E., Machnicki, C., Bhaskar, D., Cui, F., Wong, I. *Polymer Chemistry* 10 (16), 2015-2028, 2019.
- J2 **Coupling mechanical tension and GTPase signaling to generate cell and tissue dynamics**, Zmurchok, C., Bhaskar, D., & Edelstein-Keshet, L. *Physical Biology*, 15 (4), 046004, 2018.
- J1 **Polarization and migration in the zebrafish posterior lateral line system**, Knútsdóttir, H., Zmurchok, C., Bhaskar, D., Palsson, E., Dalle Nogare, D., Chitnis, A. B., & Edelstein-Keshet, L. *PLoS Computational Biology*, 13 (4), e1005451, 2017.

★ co-first authors, † co-senior authors

PEER-REVIEW
CONFERENCE
PAPERS

- C2 **Diffusion curvature for estimating local curvature in high dimensional data**, Bhaskar, D., MacDonald, K., Fasina, O., Thomas, D., Rieck, B., Adelstein, I., & Krishnaswamy S. *Thirty-sixth Conference on Neural Information Processing Systems (NeurIPS)*, New Orleans, USA, 2022.
- C1 **Molecular graph generation via geometric scattering**, Bhaskar, D., Grady, J., Castro, E., Perlmutter, M., & Krishnaswamy, S. *IEEE 32nd International Workshop on Machine Learning for Signal Processing (MLSP)*, Xi'an, China, pp. 1-6, 2022.

REVIEWS &
OPINION

- R3 **Multiscale geometric and topological analyses for characterizing and predicting immune responses from single cell data**, Venkat, A., Bhaskar, D., & Krishnaswamy, S. *Trends in Immunology* (in press)
- R2 **Current trends in artificial intelligence in reproductive endocrinology**, Bhaskar, D., Chang, T., & Wang S. *Current Opinion in Obstetrics and Gynecology*, 34 (4), 159-163, 2022.
- R1 **The need for speed: Migratory cells in tight spaces boost their molecular clock**, Bhaskar, D., Hruska, A., & Wong, I. *Cell Systems*, 13 (7), 509-511, 2022.

PREPRINTS

- P6 **Topological data analysis of spatial patterning in heterogeneous cell populations: Clustering and sorting with varying cell-cell adhesion**, Bhaskar, D., Zhang, W., Volkening, A., Sandstede, B., & Wong I. *arXiv:2212.14113* (in revision at *npj Systems Biology and Applications*)
- P5 **Inferring dynamic regulatory interaction graphs from time series data with perturbations**, Bhaskar, D., Magruder, S., De Brouwer, E., Venkat, A., Wenkel, F., Wolf, G., & Krishnaswamy, S. (submitted to *NeurIPS 2023*)
- P4 **A flowartist for high-dimensional cellular data**, Macdonald, K., Bhaskar, D., Thampakkul, G., Nguyen, N., Zhang, J., Perlmutter, M., Adelstein, I., & Krishnaswamy S. (submitted to *IEEE MLSP 2023*)
- P3 **Wire Before You Walk**, Asmara, T., Bhaskar, D., Adelstein, I., Krishnaswamy, S., & Perlmutter, M. (submitted to *Asilomar Conference on Signals, Systems, and Computers, 2023*)

PREPRINTS (Contd.)	P2 Learnable filters for geometric scattering modules , Tong, A., Wenkel, F., Bhaskar, D., MacDonald, K., Grady, J., Perlmutter, M., Krishnaswamy, S., & Wolf, G. <i>arXiv:2208.07458</i>	
	P1 A methodology for morphological feature extraction and unsupervised cell classification , Bhaskar, D., Lee, D., Knútsdóttir, H., Tan, C., Zhang, M., Dean, P., Roskelley, C., & Edelstein-Keshet L. <i>bioRxiv</i> , DOI:10.1101/623793	
INVITED TALKS	Powered By DrugBank Academic Webinar Series (online)	Aug 2023
	Minisymposium on Data-driven, Modeling and Topological Techniques in Cell and Developmental Biology, SMB Annual Meeting, Ohio State University	Jul 2023
	Applied Mathematics and Computation Seminar, UMass Amherst	Feb 2023
	AMS Special Session on Modeling Collective Behavior in Biology, Joint Mathematics Meetings (JMM), Boston, MA	Jan 2023
	Pint of Postdoc, Yale Postdoc Association, New Haven, CT	Apr 2022
	Applied Topology Seminar, AATRN [Virtual]	Mar 2022
	Joint UBC and U. Utah MathBio Seminar [Virtual]	Sep 2021
	Topological Data Analysis Seminar, Michigan State University [Virtual]	Aug 2021
	Society for Mathematical Biology Annual Meeting	Jun 2021
	Applied Topology Seminar, Mathematical Institute, University of Oxford	May 2021
	Thinking Out Loud, Samuel M. Nabrit Black Graduate Student Association, Brown University	Nov 2019
	BIRS Workshop on Bridging Cellular and Tissue Dynamics from Normal Development to Cancer: Mathematical, Computational, and Experimental Approaches, Banff, AB	Jun 2019
CONTRIBUTED TALKS	3 rd Graduate Student Conference: Geometry and Topology meet Data Analysis and Machine Learning (GTDAML), Northeastern University, Boston, MA	Jun 2023
	42 nd Department of Genetics Annual Retreat, Yale School of Medicine, Westbrook, CT	Aug 2022
	The 39 th Annual (Online) Workshop in Geometric Topology [Virtual]	Jun 2022
	5 th Annual Postdoc Symposium, Yale University	May 2022
	AMS Contributed Paper Session on Algebraic Topology and Knot Theory, Joint Mathematics Meetings (JMM), Seattle, WA [Virtual]	Jan 2022
	2 nd Workshop on Topological Methods in Data Analysis, Heidelberg University [Virtual]	Oct 2021
	83 rd New England Complex Fluids Meeting, UMass Amherst	Jun 2020
	Continua Research Society Colloquium, Brown University	Apr 2019
	10 th Annual q-bio Conference, Vanderbilt University	Jul 2016
	Canadian Undergraduate Mathematics Conference, Carleton University	Jul 2014
POSTER PRESENTATIONS	Canadian Undergraduate Mathematics Conference, Université de Montréal	Jul 2013
	6 th Montreal AI and Neuroscience (MAIN) Conference, Montreal, QC	Dec 2022
	17 th Machine Learning in Computational Biology (MLCB) Conference [Virtual]	Nov 2022
	Conference on the Mathematical Theory of Deep Neural Networks (DeepMath), UC San Diego	Nov 2022
	Biomedical Engineering Society (BMES) Annual Meeting, San Antonio, TX	Oct 2022

POSTER
PRESENTATIONS
(Contd.)

21 st European Conference on Computational Biology (ECCB), Sitges, Spain	Sep 2022
Bridging Applied and Quantitative Topology Workshop, AATRN [Virtual]	May 2022
Workshop on Geometrical and Topological Representation Learning, ICLR [Virtual]	Apr 2022
Learning Meaningful Representations of Life (LMRL) Workshop, NeurIPS [Virtual]	Dec 2021
ELLIS Machine Learning for Molecule Discovery Workshop, NeurIPS [Virtual]	Dec 2021
Applied Algebraic Topology Research Network (AATRN) Poster Session [Virtual]	Oct 2021
American Society for Reproductive Medicine Scientific Congress & Expo [Virtual]	Oct 2020
Society for Mathematical Biology Annual Meeting [†] [Virtual]	Aug 2020
New England Computer Vision Conference, Brown University	Dec 2019
Biomedical Engineering Society (BMES) Annual Meeting, Philadelphia, PA	Oct 2019
Frontiers in Biophysics Conference, UBC	Jun 2017
Frontiers in Biophysics Conference, SFU	Jun 2016
Multidisciplinary Undergraduate Research Conference, UBC	Mar 2015
Frontiers in Biophysics Conference, UBC	Mar 2015
Mathematics at the Frontier of Developmental Biology Workshop, PIMS/UBC	Jul 2014

[†] Winner of the best poster award in the Mathematical Oncology subgroup

TEACHING
EXPERIENCE

Guest Lectures:

MATH 322a - Geometric and Topological Methods in Machine Learning	Yale, Fall '22
CEMA 0919 - An Introduction to Applied Mathematics	Summer@Brown '19

Graduate/Undergraduate Teaching Assistant:

DATA 1010 - Probability, Statistics & Machine Learning	Brown University, Fall '19
ENGN 2912B - Scientific Programming in C++	Brown University, Fall '18
CPSC 313 - Computer Hardware & Operating Systems	UBC, Summer '16 & '17
MATH 257/316 - Partial Differential Equations	UBC, Fall '16
MATH 256 - Differential Equations	UBC, Spring '16
MATH 253 - Multivariable Calculus	UBC, Fall '15
MATH 307 - Applied Linear Algebra	UBC, Fall '15
CPSC 259 - Data Structures & Algorithms for Electrical Engineers	UBC, Spring '13 & '14
CPSC 260 - Data Structures & Algorithms for Computer Engineers	UBC, Fall '12
CPSC 260 - Object-Oriented Program Design (old syllabus)	UBC, Summer '11
CPSC 101 - Connecting with Computer Science	UBC, Spring '11, Summer '11
CPSC 211 - Introduction to Software Development (old syllabus)	UBC, Fall '10

- Developed autograder software, lectured on OpenMP, MPI and OpenACC, and mentored HPC-related course projects for ENGN 2912B
- Created a guide for using MATLAB Engine C++ API on GNU/Linux for CPSC 259
- Taught tutorial sections for all Computer Science (CPSC) courses and MATH 256 at UBC

Pedagogical Training:

Teaching Consultant Program , Brown Sheridan Center	2020
Course Design Seminar , Brown Sheridan Center	2020
Reflective Teaching Seminar , Brown Sheridan Center	2019
Instructional Skills Workshop , UBC Center for Teaching, Learning and Technology	2016

MENTORSHIP

Yale College First-Year Summer Research Fellowship in the Sciences & Engineering**Topic:** Adversarial Knowledge Graph Embedding for Indication Expansion **Summer 2022****Student:** Garrek Chan (Saybrook College, Class of 2025)**Summer Undergraduate Math Research at Yale (SUMRY)****Topic:** Directed-graph based Inference in Machine Learning **Summer 2022****Students:** Tesfa Asmara, Kincaid MacDonald, Nhi Nguyen, Guy Thampakkul & Joia Zhang**Topic:** Diffusion Geometry and Topology **Summer 2021****Students:** Kincaid MacDonald, Jennifer Paige, Dawson Thomas & Sarah Zhao**Independent Study Projects****Topic:** Identifying Transitions in Collective Cell Behavior using TDA **Spring 2020****Student:** William Zhang (Brown University, Sc.B.'22)**Topic:** Diffusion Geometry and Topology **Fall 2020****Student:** William Zhang (Brown University, Sc.B.'22)**BrownConnect Collaborative SPRINT Award****Topic:** Data-driven Modeling of Collective Motion on Curved Surfaces in 3D **Summer 2020****Student:** Tej Stead (Brown University, Sc.B.'23)**Brown University Undergraduate Teaching and Research Award****Topic:** Computational Models of Swarming and Collective Cell Motility **Spring 2019****Student:** Subhanik Purkayasta (Brown University, Sc.B.'21)**Undergraduate Honors Thesis****Topic:** Profiling EMT in 3D Microenvironments Using TDA **Sep 2018 - May 2019****Student:** Zachary J. Neronha (Brown University, Sc.B.'19)**NSERC Undergraduate Summer Research Award****Topic:** Cell Cluster Analysis and Neighbour Detection **Summer 2017****Student:** Cindy Tan (UBC, B.Sc.'19)**Topic:** Simulating Cell-Cell Interactions and Migration in Multicellular Tissues **Summer 2017****Student:** MoHan Zhang (UBC, B.Sc.'18)**Topic:** Morphology-Based Cell Classification **Summer 2016****Student:** Darrick Lee (UBC, B.A.Sc.'16)**Topic:** Extending the CHASTE Open Source C++ Simulation Library **Summer 2015****Student:** Eviatar Bach (UBC, B.Sc.'17)SERVICE AND
LEADERSHIP**Co-Organizer:**AMS Special Session on "Geometry and Topology of High-Dimensional Biomedical Data, I",
Joint Math Meetings, San Francisco, CA **Jan 3-6, 2024**6th Annual Yale Postdoc Symposium, Yale University, New Haven, CT **May 25, 2023**Minisymposium on "The Convergence of Data, Geometry, and Biology: Insights from the
'shape' of Biological Data", Sigma Xi International Forum for Research Excellence (IFoRE),
Alexandria, VA **Nov 3-6, 2022**

SERVICE AND
LEADERSHIP
(Contd.)**Reviewer:**

Journals: Nature Communications Materials, Cell Systems, PLOS Computational Biology
Conferences: RSGDREAM 2022 (RECOMB/ISCB), SampTA 2023
Workshops: LMRL Workshop 2022 (NeurIPS)

Membership:

Professional: AMS (2019 –), SIAM (2023 –), SMB (2017 –), BMES (2019 –)
Honor Societies: Sigma Xi, Golden Key International Honour Society

WORKSHOPS AND
TRAINING

Virtual Hands-on Workshop on Computational Biophysics, National Center for Multiscale Modeling of Biological Systems (MMBioS) [Virtual Event]	Jul 5 - 8, 2022
OxML.2020 Machine Learning Summer School [†] , Oxford University [Virtual Event]	Aug 17 - 25, 2020
Petascale Computing Institute [Virtual Event]	Aug 19 - 23, 2019
AMS Mathematic Research Communities Program on Modeling in Biological and Social Systems, West Greenwich, RI	Jun 17 - 23, 2018
Research Computing Summer School, UBC	Jun 19 - 22, 2017
Tenth q-bio Summer School on Membrane Dynamics, University of New Mexico	Jul 11 - 22, 2016
EMBO Course on Multi-level Modelling of Morphogenesis, John Innes Centre, Norwich, UK	Jul 12 - 24, 2015
Joint CAMBAM-MBI-NIMBioS Summer School on Nonlinear Dynamics in Biological Systems, McGill University	Jun 1 - 12, 2015

[†] Among top 12% applicants accepted into the program

REFERENCES

Prof. Smita Krishnaswamy, *Yale University*
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