

Dhananjay Bhaskar

PERSONAL	<i>Email:</i> dhananjay.bhaskar@brown.edu <i>Address:</i> Apt 2, 134 Benefit St Providence, RI, 02903	<i>Mobile:</i> (+1) 401-338-9829 <i>Website:</i> dhananjaybhaskar.com <i>Citizenship:</i> Indian
EDUCATION	Brown University , Providence, USA Ph.D. - Biomedical Engineering (with Doctoral Certificate in Data Science) Advisor: Prof. Ian Y. Wong <ul style="list-style-type: none">• Sheridan Course Design Seminar (Certificate II, 2020)• Elected Associate Member, Sigma Xi (2019)• Sheridan Reflective Teaching Seminar (Certificate I, 2019)• E Paul Sorensen Graduate Fellowship (2017)<ul style="list-style-type: none">◦ Graduate Representative, BMEB Diversity & Inclusion Committee (2019 - 2020) University of British Columbia , Vancouver, Canada M.Sc. - Applied Mathematics Dissertation: Morphology Based Cell Classification: Unsupervised Machine Learning Approach Advisor: Prof. Leah Edelstein-Keshet <ul style="list-style-type: none">• Faculty of Science Graduate Award (2016)• International Tuition Scholarship (2015 - 2017)• Full Teaching Assistantship (2015 - 2017)• Research Assistantship (2015 - 2017) University of British Columbia , Vancouver, Canada B.Sc. - Combined Major in Computer Science and Mathematics (with distinction) <ul style="list-style-type: none">• Work Learn International Undergraduate Summer Research Award (2014)• CS Volunteering Award (2013)• Trek Excellence Scholarship (2010)• Summer Scholarship (2010)• President's Entrance Scholarship (2009)<ul style="list-style-type: none">◦ Undergraduate Representative, CS Communications Committee (2012 - 2013)◦ Community Events Organizer, CS Undergraduate Volunteering Committee (2009 - 2010)	Sep 2017 - 2021 (Expected) Sep 2015 - May 2017 Sep 2009 - Dec 2014
RESEARCH EXPERIENCE	Graduate Researcher , Brown University, Providence Center for Biomedical Engineering <ul style="list-style-type: none">◦ Quantified cancer morphology and motility by automatically segmenting and classifying cell cluster shapes in 2-D and 3-D assays◦ Automated assessment and selection of cultured human embryos for implantation in IVF to treat infertility using VAE and GAN architectures◦ Developed mathematical and computational models of cell aggregation, gradient sensing and quorum sensing◦ Used Topological Data Analysis (TDA) to characterize collective behavior observed in agent-based models of swarming◦ Estimated fiber density and alignment in silk-collagen composite hydrogels using Second Harmonic Generation (SHG) microscopy images	Sep 2017 - Present

Graduate Research Assistant, UBC, Vancouver**Sep 2015 - Jun 2017**

Institute of Applied Mathematics

- Developed an automated pipeline to segment fluorescent and phase-contrast microscopy images, track cells over time and collect statistics to guide future experimental work
- Classified cells in microscopy images by extracting morphological features (using differential geometry and curve-fitting), performing feature selection, dimension reduction and unsupervised classification
- Simulated cell sorting, tissue folding, wound healing and cancer invasion using the lattice-based cellular Potts model and mesh-based vertex dynamics models
- Investigated cellular oscillations resulting from two-way feedback between Rac-Rho GTPase activity and mechanical tension using Potts model simulations

Undergraduate Research Assistant, UBC, Vancouver**May 2014 - Sep 2015**

Department of Mathematics

- Developed multiscale simulations of epithelial morphogenesis using the Cancer, Heart and Soft Tissue Environment (CHASTE) framework
- Studied collective cell migration and cell signalling during development of Zebrafish mechanosensory system using computational models
- Used high-performance computing to automate large parameter sweeps of soft-tissue simulations and identify transitions in behavior
- Empirically compared simulation results for various mathematical models of intercellular interactions resulting from mechanical stress, contact inhibition and differential cell adhesion

Summer Research Assistant, Thompson Rivers University, Kamloops**May - Aug, 2013**

Department of Mathematics and Statistics

- Assessed solution quality and runtime performance of Particle Swarm Optimization (PSO), Tabu Search (TS), Genetic Algorithms (GA), Simulated Annealing (SA) and Krill Herd (KH) on benchmark multi-modal optimization problems
- Implemented hybrid metaheuristic algorithms based on GA, PSO and stochastic local search in MATLAB for solving the unconstrained binary quadratic programming (UBQP) problem
- Obtained numerical results to compare accuracy of mimetic PSO algorithms for binary and integer optimization problems specified in Operations Research Library (ORLIB) benchmark

PUBLICATIONS

- **Topological Data Analysis of Collective and Individual Phases in a Minimal Model of Epithelial Cells**, Bhaskar, D., Zhang, W., & Wong, I. [Submitted, [arXiv:2003.10008](#)]
- **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. [In Review, [bioRxiv:10.1101/623793](#)]
- **Analyzing Collective Motion with Machine Learning and Topology**, Bhaskar, D., Manhart, A., Milzman, J., Nardini, J., Storey, K., Topaz, C., & Ziegelmeier, L. (2019). *Chaos* 29, 123125.
- **Motility-limited aggregation of mammary epithelial cells into fractal-like clusters**, Leggett, S., Neronha, Z., Bhaskar, D., Sim, J., Perdikari, T., & Wong, I. (2019). *PNAS* 116 (35), 17298-17306.
- **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. (2019). *ACS Biomaterials Science & Engineering*.

- **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. (2019). *Polymer Chemistry* 10 (16), 2015-2028.
- **Coupling mechanical tension and GTPase signaling to generate cell and tissue dynamics**, Zmurchok, C., Bhaskar, D., & Edelstein-Keshet, L. (2018). *Physical Biology*, 15, 046004.
- **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. (2017). *PLoS Computational Biology*, 13(4), e1005451.

SEMINAR AND CONFERENCE PRESENTATIONS

- **Using Topological Data Analysis to Quantify Pattern Formation in Active Matter**, 83rd New England Complex Fluids (NECF) Meeting, UMass Amherst, MA, 2020 [Virtual Event]
- **Automated Assessment of Human Embryo Development for In-Vitro Fertilization Treatment**, New England Computer Vision (NECV) Conference, Providence, RI, 2019
- **When Machines Make (Bad) Decisions**, Thinking Out Loud (organized by the Samuel M. Nabrit Black Graduate Student Association), Providence, RI, 2019
- **Characterizing Transitions in Tissue Architecture using Topological Data Analysis**, Biomedical Engineering Society (BMES) Annual Meeting, Philadelphia, PA, 2019
- **Deducing Dynamical Rules via Machine Learning and Topology**, Joint Mathematics Meetings, Baltimore, MD, 2019
- **A Novel Approach to Investigate Transitions in Tumor Tissue Architecture using Computational Topology**, Continua Research Society (CRS) Colloquium, Providence, RI, 2018
- **A Model for Rho GTPase Dynamics in Epithelial Monolayers**, Frontiers in Biophysics Conference, University of British Columbia, Vancouver, BC, 2017
- **Modeling Latency Reversal in HIV-1 Infection**, 10th Annual q-bio Student Symposium and Conference, Vanderbilt University, Nashville, TN, 2016
- **Understanding Collective Cell Migration**, Frontiers in Biophysics Conference, Simon Fraser University, Burnaby, BC, 2016
- **Invasion Fronts and Tissue Dynamics**, Multidisciplinary Undergraduate Research Conference (MURC), University of British Columbia, Vancouver, BC, 2015
- **Modeling Posterior Lateral Line Primordium in Zebrafish**, Frontiers in Biophysics Conference, University of British Columbia, Vancouver, BC, 2015
- **Mathematical Models of Epithelial Monolayer**, Canadian Undergraduate Mathematics Conference (CUMC), Carleton University, Ottawa, ON, 2014
- **Using CHASTE (Oxford) to Explore Tissue Dynamics**, Mathematics at the Frontier of Developmental Biology Workshop, Pacific Institute for Mathematical Sciences, Vancouver, BC, 2014
- **A Metaheuristic Approach for Solving the Unconstrained Binary Quadratic Programming Problem**, Canadian Undergraduate Mathematics Conference (CUMC), Université de Montréal, Montréal, QC, 2013

TEACHING EXPERIENCE

Brown University, School of Engineering

DATA 1010 - Probability, Statistics and Machine Learning

Fall 2019

ENGN 2912B - Scientific Programming in C++

Fall 2018

- Wrote in-class problem sets and homework assignment problems for DATA 1010
- Developed course material on high performance computing (OpenMP, MPI and OpenACC) for ENGN 2912B
- Mentored course projects on data visualization, multi-threaded and socket programming, GPU computing, embedded systems and finite-element modeling for ENGN 2912B

UBC, Department of Mathematics and Department of Computer Science

Graduate Teaching Assistant for:

MATH 257/316 - Partial Differential Equations	Fall 2016
CPSC 313 - Computer Hardware and Operating Systems	Summer 2016, 2017
MATH 256 - Differential Equations	Winter 2015
MATH 253 - Multivariable Calculus	Fall 2015
MATH 307 - Applied Linear Algebra	Fall 2015

- Held office hours at the Math Learning Centre (MLC) and taught tutorial sections
- Invigilated and marked exams, graded homework assignments
- Assisted students with scientific computation in MATLAB and Octave for MATH 307/316

UBC, Department of Computer Science

Undergraduate Teaching Assistant for:

CPSC 259 - Data Structures and Algorithms for Electrical Engineers	Winter 2012, 2013
CPSC 260 - Data Structures and Algorithms for Computer Engineers	Fall 2012
CPSC 260 - Object-Oriented Program Design (old offering)	Summer 2011
CPSC 101 - Connecting with Computer Science	Winter 2010, Summer 2011
CPSC 211 - Introduction to Software Development	Fall 2010

- Supervised labs, proctored exams, marked assignments and taught tutorial sections
- Designed labs and developed course material for CPSC 101
- Created a guide demonstrating how to compile and link C++ programs that use the MATLAB engine library on GNU/Linux for CPSC 259

**INDUSTRY
EXPERIENCE****Software Developer, Clinemetrica Inc., Montréal, QC** **Sep - Dec, 2013**

Contract Research and Corporate Health Organization

- Generated online risk assessment reports for diabetes, cardiovascular disease, (mal-)nutrition and physical fitness from self-reported health records using MySQL, PHP and jQuery
- Developed a user tracking system to monitor customer engagement and report findings to senior developers using AJAX, jQuery, HighCharts JS and PHP
- Designed and implemented a web application for non-technical users creating interactive educational content online

Grid Computing Assistant, TRIUMF, Vancouver, BC **May - Aug, 2012**National Laboratory for Particle and Nuclear Physics and, **Sep - Dec, 2011**

- Research and initial implementation of a server daemon that tracks external connections to the data center for intrusion detection and checks validity of grid certificates
- Developed Perl scripts to automate common system administration tasks, collect log files, and parse logs to automatically flag issues affecting grid performance
- Designed web interface to monitor a 5.5 PB tape storage database
- Set up a test environment for OpenStack cloud computing services by installing and configuring key components using two servers
- Attended the High Energy Physics Unix Information Exchange (HEPiX) Conference (Fall 2011)

WORKSHOPS

OxML.2020 Machine Learning Summer School (Virtual Event) **Aug 17 - 25, 2020**

Organized By: AI for Global Goals and in partnership with CIFAR, Oxford Saïd Business School and Oxford Deep Medicine program

Topics Covered: Bayesian ML, Computer Vision, NLP, Reinforcement Learning, Causal ML, Topological ML and Transfer Learning

Petascale Computing Institute (Virtual Event) **Aug 19 - 23, 2019**

Co-organized By: Argonne National Laboratory (ANL), the Blue Waters project at NCSA, the National Energy Research Scientific Computing Center (NERSC), Oak Ridge Leadership Computing Facility (OLCF), Pittsburgh Supercomputing Center, SciNet at the University of Toronto, and the Texas Advanced Computing Center (TACC)

Topics Covered: OpenMP, MPI, Hybrid Programming, OpenACC, CUDA, HPC in Python, Data Visualization, Containers (Docker and Singularity), HPC I/O (Parallel-NetCDF, HDF5), Debugging and Profiling

Modeling in Biological and Social Systems, West Greenwich, RI **Jun 17 - 23, 2018**

Organized By: AMS Mathematical Research Communities, 2018

Topics Covered: Animal swarming models, Continuum limit for agent-based models, Kinetic Monte Carlo method, Topological data analysis, Parameter estimation

Research Computing Summer School, UBC, Vancouver **Jun 19 - 22, 2017**

Organized By: UBC Advanced Research Computing (ARC) and Westgrid

Topics Covered: Grid computing on Compute Canada cloud, Parallel and distributed computing in Julia, Hybrid programming (OpenMP and MPI), GPU programming (CUDA and OpenACC), Scientific visualization using ParaView

Tenth q-bio Summer School, University of New Mexico **Jul 11 - 22, 2016**

Theme: Membrane Dynamics

Topics Covered: Rule-based modeling (BioNetGen, Simmune, ML-Rules, COPASI), Doob-Gillespie algorithm, Spatial stochastic simulations (StochSS, PyURDME), STORM microscopy, Single particle tracking (using Q-Dots and Alexa 488), Viral dynamics

EMBO Practical Course, John Innes Centre, Norwich, UK **Jul 12 - 24, 2015**

Theme: Multi-level Modelling of Morphogenesis

Topics Covered: Pattern formation, Cellular Automata, Reaction-diffusion models, Excitable media, Individual cell-based models, Gene regulatory networks, Boolean networks, L-systems, Eco-Evo-Devo

Joint CAMBAM-MBI-NIMBioS Summer School, McGill University **Jun 1 - 12, 2015**

Theme: Nonlinear Dynamics in Biological Systems

Topics Covered: Bifurcation methods, Cell electrophysiology, Reaction kinetics, Stochastic dynamics, Ecological systems, Coupled oscillators, Phase locking and synchrony