# DEXTER BARROWS

## CURRICULUM VITAE

dexter.barrows.io
dexter@barrows.io

## *Education*

### *Doctor of Philosophy – Mathematics*

RYERSON UNIVERSITY 2022

Developing new optimisations for techniques designed for the simulation of biochemical reaction-diffusion systems. Focus is on the utilisation of inference schemes to determine optimal parameters for accurate and efficient simulations, and the development of R/C++ software packages to make these enhancements available to practitioners.

THESIS *Efficient stochastic simulation of reaction-diffusion networks*
SUPERVISORS Dr. Silvana Ilie & Dr. Katrin Rohlf

### *Master of Science – Applied Mathematics*

MCMASTER UNIVERSITY 2016

Examined techniques for parameter inference and forecasting of time series, within the context of epidemic forecasting. Developed and utilised massively parallel implementations of iterated particles filters in R/C++/CUDA.

THESIS *A Comparative Study of Techniques for Estimation and Inference of Nonlinear Stochastic Time Series*
SUPERVISOR Dr. Ben Bolker
https://github.com/dbarrows/epidemic-forecasting

### *Bachelor of Science, with Distinction – Mathematics and Computer Science*

RYERSON UNIVERSITY 2014

Created software framework for the simulation of biochemical kinetics, including a novel application of the Multi-level Monte-Carlo method to this domain, in MATLAB/CUDA.

THESIS *Software for Multi-level Monte-Carlo Simulation of Stochastic Biochemical Kinetics*
SUPERVISOR Dr. Silvana Ilie
https://github.com/dbarrows/biochemical-kinetics

## *Professional Experience*

### *Software Developer*

7D SURGICAL 2017–2019

Developed software for image-guided surgical navigation of the spine and cranium. Built software components for medical embedded systems, with a focus on algorithms for GPU-accelerated 3D image processing and UI design.

LANGUAGES C#, C++
FRAMEWORKS CUDA, WPF

### *Research Assistant*

BIOPHOTONICS AND BIOENGINEERING LABORATORY (BBL) 2015–2017

Designed algorithms for GPU-accelerated medical image processing and semi-automated anatomical segmentation.

LANGUAGES C++, MATLAB
FRAMEWORKS CUDA

### *Data Analyst*

CANADIAN SOCIETY OF ASSOCIATION EXECUTIVES (CSAE) 2013

Performed data sourcing, verification, and analysis.

## *Teaching Experience*

### *Graduate Assistant*

RYERSON UNIVERSITY 2019–PRESENT

Run tutorials and labs, and invigilate and grade quizzes/tests/exams.

COURSES Numerical Analysis, Linear Algebra

LANGUAGES MATLAB

### *Teaching Assistant*

MCMASTER UNIVERSITY 2014–2016

Ran tutorials and labs, and invigilated and graded tests/exams.

COURSES Introduction to Scientific Computing, Calculus for Life Sciences

LANGUAGES Python

### *Math and Science Tutor*

THE MATH GURU 2010–2014

Taught mathematics, physics, and computer science up to university level.

LANGUAGES Python

## *Awards*

### *Postgraduate Scholarship – Doctoral (PGS D)*

THE NATIONAL SCIENCE AND ENGINEERING RESEACH COUNCIL OF CANADA (NSERC) 2020–2023

National scholarship supporting high-calibre scholars who are engaged in doctoral programs in the natural sciences or engineering.

### *Queen Elizabeth II – Science and Technology (QEII-GSST)*

RYERSON UNIVERSITY / THE PROVINCE OF ONTARIO 2019–2020

Provincial merit-based scholarship for students in a graduate research-based programs in a science and technology discipline.

## *Journal Publications*

*Optical coherence tomography for dynamic axial correction of an optical end-effector for robot-guided surgical laser ablation*

OPTICAL ENGINEERING 2019

AUTHORS J Jivraj, C Chen, D Barrows, VXD Yang

https://doi.org/10.1117/1.OE.58.5.054106

*Optimization of laser osteotomy at 1064 nm using a graphite topical absorber and a nitrogen assist gas jet*

BIOMEDICAL OPTICS EXPRESS 2019

AUTHORS J Jivraj, D Barrows, X Gu, VXD Yang

https://doi.org/10.1364/BOE.10.003114

## *Conference Presentations*

*Efficient techniques for inferring stochastic biochemical system reaction rates*
CANADIAN APPLIED AND INDUSTRIAL MATHEMATICS SOCIETY (CAIMS) ANNUAL MEETING 2021

AUTHORS D Barrows, S Ilie

*Optimal bath particle density selection for Reactive Multiparticle Collision dynamics*
CANADIAN APPLIED AND INDUSTRIAL MATHEMATICS SOCIETY (CAIMS) ANNUAL MEETING 2021

AUTHORS D Barrows, K Rohlf

*Inference of Stochastic Biochemical System Reaction Rates*
INTELLIGENT SYSTEMS FOR MOLECULAR BIOLOGY (ISMB) 2020

AUTHORS D Barrows, S Ilie

*A Software Ecosystem for Stochastic Biochemical Network Simulation in R*
SIAM/CANADIAN APPLIED AND INDUSTRIAL MATHEMATICS SOCIETY (CAIMS) ANNUAL MEETING 2020

AUTHORS D Barrows, K Rohlf, S Ilie

*Graphics processor unit acceleration enables realtime endovascular Doppler optical coherence tomography imaging*
SPIE PHOTONICS WEST 2017

AUTHORS D Barrows, B Vuong, K Lee, J Jivraj, VXD Yang
https://doi.org/10.1117/12.2254930

*Graphics processor unit acceleration enables realtime endovascular Doppler optical coherence tomography imaging: development and validation*
SPIE PHOTONICS WEST 2017

AUTHORS D Barrows, JM Ramjist, B Vuong, K Lee, J Jivraj, VXD Yang
https://doi.org/10.1117/12.2256623

*Assessment of haemodynamics of intracranial aneurysms using Doppler optical coherence tomography in patient specific phantoms: preliminary results*
SPIE PHOTONICS WEST 2017

AUTHORS JM Ramjist, J Jivraj, D Barrows, B Vuong, R Wong, VXD Yang
https://doi.org/10.1117/12.2256532

## *Invited Presentations & Trainings*

*The Stochastic Simulation Algorithm*
RYERSON UNIVERSITY, DEPARTMENT OF MATHEMATICS 2021

*Inhomogeneous biochemical systems: modelling and stochastic simulation*
RYERSON UNIVERSITY, DEPARTMENT OF MATHEMATICS 2020

*Biochemical systems: modelling and stochastic simulation*
RYERSON UNIVERSITY, DEPARTMENT OF MATHEMATICS 2019

*Spatiotemporal models*
MCMASTER UNIVERSITY, DEPARTMENT OF MATHEMATICS & STATISTICS 2015

*Julia sets*
MCMASTER UNIVERSITY, DEPARTMENT OF MATHEMATICS & STATISTICS 2015

*Epidemic forecasting: review of the state of the art*
MCMASTER UNIVERSITY, DEPARTMENT OF MATHEMATICS & STATISTICS 2015

*Fringe: software for OCT data acquisition and imaging*
BIOPHOTONICS AND BIOENGINEERING LABORATORY 2016

*Git & Github*
BIOPHOTONICS AND BIOENGINEERING LABORATORY 2016

*Models for systems of biochemical reactions: simulation and software implementation*
RYERSON UNIVERSITY, DEPARTMENT OF MATHEMATICS 2014

## *Software*

**rendr**
R PACKAGE 2020

An R package for simulating reaction and reaction-diffusion systems.

LANGUAGES R, C++
FRAMEWORKS OpenMP
https://dexter.barrows.io/rendr

**mountie**
R PACKAGE 2020

An R package providing an efficient C++ implementation of the Reactive Multi-Particle Collisions (RMPC) algorithm.

LANGUAGES R, C++
FRAMEWORKS OpenMP
https://dexter.barrows.io/mountie

**bondr**
R PACKAGE 2020

Provides utilities and classes for working with reaction networks in R.

LANGUAGES R, C++
https://dexter.barrows.io/bondr

**wplot**
R PACKAGE 2020

A clean theme for ggplot2 with matching geom defaults.

LANGUAGES R
https://dexter.barrows.io/wplot

**Fringe**
WINDOWS APPLICATION 2016

Program for Optical Coherence Tomography (OCT) data acquisition and imaging.

LANGUAGES C++
FRAMEWORKS CUDA, OpenGL

**MARS**
MATLAB TOOLKIT 2014

Toolkit for simulating well-stirred biochemical systems.

LANGUAGES MATLAB
FRAMEWORKS CUDA
https://github.com/dbarrows/biochemical-kinetics/tree/master/code

## *Certifications*

### *LBR iiwa – Commissioning and Programming*
KUKA COLLEGE 2017

Operation and programming of the KUKA LBR iiwa personal robotic assistant, including safe interaction, manual operation, basic maintenance, authoring robotic applications, and debugging.

LANGUAGES Java

## *Leadership*

### *President, Mathematics Course Union (MCU)*
RYERSON UNIVERSITY 2013–2014

Acted as a liaison between students, the Department of Mathematics, and the Faculty of Science.

COMMITTEES Curriculum Advising Committee, By-law Revising Subcommittee, Ryerson Science Society (RSS) Steering Committee

### *Vice President – Financial, Ryerson Science Society (RSS)*
RYERSON UNIVERSITY 2012-2013

Ensured transparent flow of financial resources for student events