

Martin Magill

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SKILLS

Mathematics: Differential equations, multiscale modelling, Markov chains
Science: Biophysics, electromagnetism, radiation, fluid/solid mechanics
Programming: Python, MATLAB, C, C++, OpenMP, HTML, CSS, JavaScript, Git
Python: TensorFlow, PyTorch, Scipy, Pandas, Numba, Matplotlib, Bokeh
Software: Linux, HOOMD-blue, ESPResSo, Serpent, MCNP, Geant4, Mathematica
Deep Learning: SciML, transfer learning, trustworthiness, anomaly detection
Languages: English, French

EXPERIENCE

2019/4–present **CEO/CTO and Co-Founder**

Altrina AI Incorporated

Startup developing state-of-the-art scientific machine learning tools for industrial applications.

- Generated \$60k+ via entrepreneurial/pitch competitions, research grants, and sales
- Headed customer discovery in power, manufacturing, and biotechnology sectors
- Developed a novel neural network solver for hyperelastic solid deformation
- Built a GUI with interactive 3D graphics (JavaScript, Node.js, Three.js, React)
- Led a consulting project on fault detection in power grids using time series analysis

2017/1–present **Doctoral Student (Ph.D.) – Computational Nanobiophysics Lab**
University of Ontario Institute of Technology

- Applied deep learning research
 - Used neural networks to enhance or replace stochastic molecular dynamics simulations
 - Systematically explored questions of trustworthiness
- Basic deep learning research
 - Proposed a new method for analysing representations learned by neural networks
 - Validated against prior art, which used transfer learning; achieved 1000x speedup
- Computational biophysics research
 - Modelled and simulated devices for DNA manipulation
 - Supported experimental partners with data analysis and physical insights

2014/9–2016/12 **Graduate Student (M.Sc.) – Computational Nanobiophysics Lab**
University of Ontario Institute of Technology

- Demonstrated non-monotonic DNA sorting in a novel nanopore-cavity device

2014/5–2014/8 **Undergraduate Research Assistant – Fluids Lab**
University of Waterloo

- Wrote pseudospectral solvers for ferrofluid and solar plasma systems (MATLAB, C, OpenMP)

2013/5–2013/8 **Co-op Student – Computational Reactor Physics Group**
Atomic Energy of Canada Limited

- Conducted a variety of nuclear reactor simulation studies (Serpent, MCNP)

2012/9–2012/12 **Physics Technician – Medical Physics Group**
Grand River Regional Cancer Centre

- Created a GUI for planning radiotherapy treatment schedules (MATLAB, GUIDE)

2012/1–2012/4 **Undergraduate Research Assistant – Radiation Protection Bureau**
Health Canada

- Trained ML algorithms to find nuclear materials hidden in cargo containers (Geant4, Weka)

2011/1–2011/8 **Undergraduate Research Assistant – DEAP Dark Matter Collaboration**
SNOLAB

- Characterized a technique for automatic detector calibration (Geant4, C++)

2010/5–2010/8 **Undergraduate Research Assistant – Advanced Fuels and Fuel Cycles**
Deep River Science Academy and Atomic Energy of Canada Limited

- Optimized fuel bundle designs for the SCWR reactor (WIMS, MCNP)
- Supervised two high school students

2009/7–2009/8 **Summer Student – Advanced Fuels and Fuel Cycles**
Atomic Energy of Canada Limited

- Simulated neutronics and burnup of advanced nuclear reactor fuel designs (WIMS)

2008/9–2009/1 **High School Co-op Student – Advanced Fuels and Fuel Cycles**
Atomic Energy of Canada Limited

- Modelled the flow of nuclear reactor waste in advanced fuel cycles (Excel)

EDUCATION

Expected 2022	Ph.D., Modelling and Computational Science University of Ontario Institute of Technology Supervisors: Hendrick W. de Haan and Ed Waller Thesis: <i>Solving Partial Differential Equations in Computational Nanobiophysics using Deep Neural Networks</i>
2016	M.Sc., Modelling and Computational Science University of Ontario Institute of Technology Supervisors: Hendrick W. de Haan and Ed Waller Thesis: <i>Characterization of Nanopores With Internal Cavities for DNA Manipulation Using Langevin Dynamics Simulations</i>
2014	B.Math., Honours Applied Mathematics with Physics Option University of Waterloo Co-operative Program Awarded With Distinction

AFFILIATIONS

2019–2021	Postgraduate Affiliate, Vector Institute
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PUBLICATIONS

JOURNAL ARTICLES, PEER-REVIEWED

- 2020 *Neural network solutions to differential equations in nonconvex domains: Solving the electric field in the slit-well microfluidic device.*
Magill, M., A. M. Nagel, H. W. de Haan.
 Physical Review Research. 2020.
- 2019 *Entropic trapping of DNA with a nanofiltered nanopore.*
 Lam, M. H., K. Briggs, K. Kastritis, **M. Magill**, G. R. Madejski, J. L. McGrath, H. W. de Haan, V. Tabard-Cossa.
 ACS Applied Nano Materials. 2019.
- 2019 *Dynamics of nonlinear Alfvén waves in the shallow water magnetohydrodynamic equations.*
Magill, M., A. Coutino, B. A. Storer, F. Poulin, M. Stastna.
 Physical Review Fluids. 2019.
- 2018 *A sequential nanopore-channel device for polymer separation.*
Magill, M., E. Waller, H. W. de Haan.
 The Journal of Chemical Physics. 2018.
- 2018 *DNA Translocations Through Nanopores Under Nanoscale Pre-Confinement.*
 Briggs, K., G. Madejski, **M. Magill**, K. Kastritis, H. W. de Haan, J. L. McGrath, and V. Tabard-Cossa.
 Nano Letters. 2017. [FEATURED ON THE COVER]
- 2016 *Translocation Time through a Nanopore with an Internal Cavity Is Minimal for Polymers of Intermediate Length.*
Magill, M., C. Falconer, E. Waller, and H. W. de Haan.
 Physical Review Letters. 2016.

CONFERENCE PROCEEDINGS, PEER-REVIEWED

- 2018 *Neural Networks Trained to Solve Differential Equations Learn General Representations.*
Magill, M., F. Z. Qureshi, and H. W. de Haan.
 Advances in Neural Information Processing Systems (NeurIPS). 2018.
- 2011 *Transmutation of americium in a lanthanide matrix.*
 Hyland, B., E. D. Collins, R. J. Ellis, G. Del Cul, and **M. Magill**.
 GLOBAL congress. 2011.
- 2009 *Homogeneous thorium fuel cycles in CANDU reactors.*
 Hyland, B., G. R. Dyck, G. W. R. Edwards, and **M. Magill**.
 GLOBAL congress. 2009.

OTHER CONFERENCE AND WORKSHOP PUBLICATIONS

- 2018 *Compact Neural Network Solutions to Laplace's Equation in a Nanofluidic Device.*
Magill, M., F. Z. Qureshi, H. W. de Haan.
 Workshop on Compact Deep Neural Network Representation with Industrial Applications, NeurIPS. 2018.

- 2012 *Construction, commissioning and first data from the CRIPT muon tomography project.*
Anghel, V., J. Armitage, [and 21 others, including **M. Magill**].
IEEE Nuclear Science Symposium and Medical Imaging Conference Record. 2012.
- 2012 *Machine learning for the cosmic ray inspection and passive tomography project (CRIPT).*
Stocki, T. J., C. Warren, **M. P. C. Magill** et al.
IEEE Nuclear Science Symposium and Medical Imaging Conference Record. 2012.
- 2011 *Thorium fuel cycles in the CANDU supercritical water reactor.*
Magill, M., J. Pencer, R. Pratt, W. Young, G. W. R. Edwards, and B. Hyland.
5th International Symposium on Supercritical-Water-Cooled Reactors. 2011.

WORKS IN PROGRESS

A First Passage Formulation for Electrophoretic Mobility in Periodic Geometries.
Magill, M., A. M. Nagel, H. W. de Haan.

Studying First Passage Problems using Neural Networks: A Case Study in the Slit-Well Microfluidic Device.

Nagel, A. M., **M. Magill**, and H. W. de Haan.

Characterizing Different Event Types for the Translocation of Semiflexible Polymers through a Nanopore with Capture.

Kastritis, K., **M. Magill**, and H. W. de Haan.

PRESENTATIONS

CONFERENCE PRESENTATIONS (ORAL)

- 2019 *Data-Free Deep Neural Networks for Solving Partial Differential Equations in Nanobiophysics.*
March Meeting of the American Physical Society.
- 2017 *Separation of Polymer Mixtures by Length Using a Series of Nanopores Connected by Nanochannels.*
Ontario Networking Event in Biophysics.
- 2017 *Separation of Polymer Mixtures by Length Using a Series of Nanopores Connected by Nanochannels.*
Chemical Biophysics Symposium.
- 2016 *The Translocation Time through a Nanopore with an Internal Cavity is Minimal for Polymers of Intermediate Length.*
Canadian Association of Physicists Congress.

CONFERENCE PRESENTATIONS (POSTER)

- 2021 *Solving Electric Fields in Nanofluidic Devices with Deep Neural Networks.*
Biophysical Society of Canada Annual Meeting (Online).
- 2021 *Solving Electric Fields in Nanofluidic Devices with Deep Neural Networks.*
Ontario Networking Event in Biophysics (Online).
- 2021 *Solving First Passage Problems in Nanofluidic Devices with Deep Neural Networks.*
Vector Institute Research Symposium (Online).

- 2020 *The Neural Network Method for Simulations of Soft Matter in Confinement.*
Soft Matter Canada Symposium (Online).
- 2019 *Solving First Passage Problems in Nanofluidic Devices with Deep Neural Networks.*
Biophysical Society of Canada Annual Meeting.
- 2019 *Deep learning for Laplace's equation in a challenging domain.*
Vector Institute Research Symposium.
- 2018 *Using Neural Networks to Solve Electric Fields in Slit-Well Nanofluidic Devices for Simulations of Nanoparticle Electrophoresis.*
Ontario Networking Event in Biophysics.
- 2018 *Using Neural Networks to Solve Electric Fields in Slit-Well Nanofluidic Devices for Simulations of Nanoparticle Electrophoresis.*
Chemical Biophysics Symposium.
- 2017 *Separation of Polymer Mixtures by Length Using a Series of Nanopores Connected by Nanochannels.*
Biophysical Society of Canada Annual Meeting.
- 2016 *The Translocation Time through a Nanopore with an Internal Cavity is Minimal for Polymers of Intermediate Length.*
Nano Ontario Conference.
- 2016 *The Translocation Time through a Nanopore with an Internal Cavity is Minimal for Polymers of Intermediate Length.*
Chemical Biophysics Symposium.
- 2015 *Nanopores With Internal Cavities as Band-Pass Filters for Polymer Length.*
Biophysical Society of Canada Annual Meeting.
- 2015 *Radiology of the Beta Decay Recoil Nucleus.*
Chemical Biophysics Symposium.
- 2014 *Recoil Energy in Beta Decay.*
Meeting of the University Network of Excellence in Nuclear Engineering.

OTHER PRESENTATIONS

- 2019 *Solving First Passage Problems in Nanofluidic Devices with Deep Neural Networks.*
Autodesk AI for Engineering Summer School. [POSTER]
- 2018 *Neural Networks Trained to Solve Differential Equations Learn General Representations.*
CIFAR DLRL Summer School. [POSTER]

ACADEMIC AND ADMINISTRATIVE EXPERIENCE

WORKSHOPS, READING GROUPS, AND OTHER ORGANIZATIONS

- 2021 *The Symbiosis of Deep Learning and Differential Equations.*
Workshop at NeurIPS. 2021.
- 2020–present Weekly SciML reading group offered through the Vector Institute.
- 2018–present SMA_L, an online research community for SciML researchers.

TEACHING EXPERIENCE

UNIVERSITY OF ONTARIO INSTITUTE OF TECHNOLOGY

Teaching Assistant

2014–2020 Undergraduate courses in mathematics and physics.

Volunteer Lecturer – Grad Pro Skills Seminar Series

2020, Feb Intro to Python

2019, Nov Intro to Deep Learning in Python with PyTorch

2019, Mar Intro to Deep Learning in Python with PyTorch

UNIVERSITY OF GUELPH

Guest Lecturer – Modelling Complex Systems

2020, Mar Modelling Convection-Diffusion Processes with Particles and PDEs

2019, Mar Modelling Convection-Diffusion Processes with Particles and PDEs

FUNDING

GRANT WRITING EXPERIENCE

2020–2021	Mitacs Accelerate Entrepreneur with SOSCIP Joint Project Mitacs Ref. IT21168 SOSCIP Ref. 3-076 Industrial partner: Altrina AI Incorporated Principal investigator: Hendrick W. de Haan Title: <i>Characterizing the Neural Network Method of Solving Differential Equations on Low-Dimensional Parametrized Problems from Biophysics</i> Roles: Lead co-author	\$90,000
2020–2024	NSERC Discovery Grant Principal investigator: Hendrick W. de Haan Title: <i>Combining Deep Learning and Coarse Grained Simulation Methods to Study High-Dimensional NanoBiophysical Systems</i> Roles: Co-author of the technical component	\$34,000/year for 5 years

AWARDS

2019–2021	Vector Institute Postgraduate Affiliate Award	\$6,000/year for 2 years
2017–2020	Ontario Graduate Scholarship, Doctoral	\$15,000/year for 4 years
2017–2020	Dean’s Graduate Scholarship, Doctoral	\$4,500/year for 4 years
2017	Graduate Admission Scholarship, Doctoral	\$3,000
2017	Nominated for Outstanding Master’s Thesis Award	
2016	Ontario Graduate Scholarship, Master’s	\$15,000
2014–2016	Dean’s Graduate Scholarship, Master’s	\$4,500/year for 2 years
2014	NSERC Undergraduate Student Research Award	\$4,500
2013	Arthur Beaumont Memorial Scholarship	\$3,000
2010	NSERC Undergraduate Student Research Award	\$4,500