

# XINWEN DING

40 St. George Street  $\diamond$  Toronto, ON Canada

Homepage  $\diamond$  LinkedIn

## EDUCATION

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### University of Toronto

Toronto, Ontario

*Ph.D. in Mathematics*

*September 2023 - November 2028 (expected)*

- Advisor: Adam R Stinchcombe

### University of Waterloo

Waterloo, Ontario

*Bachelor of Mathematics*

*September 2018 - May 2023*

*Triple Honours, Co-operative Program (Major) in:*

- Applied Mathematics, Combinatorics & Optimization, and Computational Mathematics
- Major average: 95.21 / 100  $\diamond$  Cumulative average: 94.48 / 100

## RESEARCH INTERESTS

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Numerical Analysis, Scientific Computing, Scientific Machine Learning

## PUBLICATIONS

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### Preprint

- Xinwen Ding, Adam R Stinchcombe (2025). **Walk-on-Interfaces: A Monte Carlo Estimator for an Elliptic Interface Problem with Nonhomogeneous Flux Jump Conditions and a Neumann Boundary Condition.**

### Paper

- Xinwen Ding, Christopher Batty. **Differentiable Curl-Noise: Procedural Incompressible Fluid Flows Without Discontinuities.** *ACM SIGGRAPH Symposium on Interactive 3D Graphics and Games*, 2023, Bellevue, WA, USA. The paper appears in the journal “*Proceedings of the ACM on Computer Graphics and Interactive Techniques*” (PACMCGIT).

## RESEARCH EXPERIENCE

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### Learning-based Monte Carlo Method for Elliptical Interface Problem

*Department of Mathematics*

*May 2024 - September 2025*

*Supervisor: Prof. Adam R Stinchcombe*

- Developed a novel Monte Carlo method for solving a class of elliptic interface problems.
- Extended the Monte Carlo algorithm by integrating a neural network, enabling a continuous and regular solution representation across multiple interfaces with irregular geometries.
- First-authored manuscript submitted.

### On Signal Decomposition Via Non-negative Matrix Factorization (NMF)

*Department of Combinatorics and Optimization, and*

*September 2022 - April 2023*

*Department of Applied Mathematics - University of Waterloo*

*Full-time Co-op*

*Supervisors: Prof. Stephen Vavasis, Prof. Giang Tran, Prof. Andersen Ang*

- Formulated the problem to decompose musical audio with dense spectrograms by the NMF method.
- Developed a model for music that enables NMF algorithm to identify features of musical signals.

## Differentiable Curl-Noise: A Procedural Visualization of Incompressible Fluid Flow

*Cheriton School of Computer Science - University of Waterloo*

*September 2021 - May 2023*

*Supervisor: Prof. Christopher Batty*

*Undergraduate Research Assistant*

- Constructed a  $C^1$  procedural method to simulate incompressible fluid and proved its differentiability; Smoothed the fluid's potential and velocity field, which enables isocontour error correction.
- Animated fluid flow using C++ and OpenGL; Pushing the fluid to float past arbitrarily shaped objects that are placed at arbitrary locations, under the effect of a  $C^1$  potential field.
- First-authored paper accepted by *ACM SIGGRAPH Symposium on Interactive 3D Graphics and Games*, 2023. To appear in the journal "*Proceedings of the ACM on Computer Graphics and Interactive Techniques*" (PACMCGIT).

## Creating Large and Uniform Optical Traps Arrays Using Spatial Light Modulators (SLM)

*Institute for Quantum Computing*

*January 2021 - August 2021*

*Supervisor: Dr. Alexandre Cooper-Roy, Prof. David Cory*

*Full-time Co-op*

- Developed the lab's first real-time, experiment-interfaceable Python simulation package; Simulated laser beam, laser beam propagation, aberration, lens focusing effect, and all experiment devices.
- Optimized a solution to a phase retrieval (inverse) problem; Retrieved phase for large ( $\mathcal{O}(10^3)$ ) traps and uniform ( $10^{-8}$  non-uniformity) trap arrays in 0.4 s, 600 times faster than the original solution.
- Developed an iterative algorithm to perform accurate, software-independent calibration for SLM; Reduced the measurement error (metric:  $\ell_2$ -norm) to  $\frac{1}{10}$  of the error under commercial solution.

## PROJECT EXPERIENCE

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### Summer Geometry Initiative (SGI)

*July 2022 - August 2022*

*Massachusetts Institute of Technology*

*2022 SGI Fellow*

- Attended hands-on tutorials introducing the theory and practice of geometry processing; Participated in multiple research projects, and wrote SGI blog posts: *[tutorial week]*, *[Project 1]*, *[Project 2]*.
- **Project 1: Plane and Edge Detection in Point Clouds**  
*Mentor: Prof. Yusuf Sahillioglu*
  - Implemented the RANSAC algorithm to detect dominant planes and edges from a given point cloud.
- **Project 2: Neural Implicit Boundary Representations**  
*Mentor: Benjamin Jones, Prof. Adriana Schulz*
  - Explored and implemented a two-phase method to define a continuous relaxation of CAD geometry.

## WORK EXPERIENCE

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### Ontario Ministry of Infrastructure

*September 2019 - December 2019*

*Research Analyst*

*Toronto, ON*

*Supervisor: Michael Leigh, Roy Hulli*

*Full-time Co-op*

- Researched on the infrastructure expenditure deficit problem; Explored and collected data; Standardized, and analyzed provincial expenditure via SQL.
- Designed and created a dynamic dashboard independently using VBA and SQL to visualize 6000 infrastructure project records (a prototyping version of the current *Ontario Builds* dashboard).
- Performed data modelling for transportation and correction sector for Ontario Multi-year Plan; Calculated financial investment data from existing government records that fits the budget model.

## HONOURS AND AWARDS

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Martin Shubik Graduate Award in Mathematics (\$5000)

*2024 - 2025*

Connaught International Scholarship (\$50000)	2023 - 2028
<ul style="list-style-type: none"> <li>A cost-sharing initiative designed to assist graduate units in recruiting and supporting top international students by providing a top-up scholarship in addition to the standard funding package.</li> </ul>	
Jessie W.H. Zou Memorial Award (Honours Mention)	2023
<ul style="list-style-type: none"> <li>Presented annually to an undergraduate student enrolled in his or her final year of any program within the Faculty of Mathematics. Students must have demonstrated excellence in research and have been nominated by a faculty member who has supervised that research.</li> </ul>	
President's Research Award (\$1500 each year)	2022-23, 2021-22 Academic Years
<ul style="list-style-type: none"> <li>Awards to undergraduate students who are undertaking a full- or part-time research experience, under the supervision of a University of Waterloo researcher.</li> </ul>	
Mathematics Undergraduate Research Award (\$6000)	2022-23 Academic Year
Term Dean's Honours List	Fall 2018 - Present
R.A. Wentzell Memorial Scholarship (\$1000)	2020-21 Academic Year
<ul style="list-style-type: none"> <li>Awards to the top male and top female students who are enrolled in year three in the Department of Applied Mathematics on the basis of academic excellence.</li> </ul>	
University of Waterloo Faculty of Mathematics Scholarship (\$5000)	2018-19 Academic Year
University of Waterloo President's Scholarship of Distinction (\$2000)	2018-19 Academic Year

## TEACHING

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### University of Toronto

Graduate Teaching Assistant

*Department of Mathematics*

- APM 236 (UTSG) - Applications of Linear Programming *Fall 2025*
- MAT244 (UTSG) - Introduction to Ordinary Differential Equations *Fall 2024 & Winter 2025*
- MAT133Y1Y (UTSG) - Calculus and Linear Algebra for Commerce *Fall 2023 & Winter 2024*
- Math Learning Center *Winter 2025*

### University of Waterloo

Undergraduate Teaching Assistant

*Faculty of Mathematics, Math Tutorial Center*

*September 2021 - April 2022*

*Supervisor: Dr. Jordan Hamilton*

- MATH 235 - Linear Algebra 2 for Honours Mathematics
- MATH 237 - Calculus 3 for Honours Mathematics

## SERVICE

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### Math Graduate Students' Association (MGSA)

- Course Planning Committee (Member) *2024 - 2025*
- Graduate Student Union (GSU) representative *2023 - 2024*

## SKILLS

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<b>Programming Languages</b>	Python, MATLAB, C/C++, R, SQL
<b>Tools</b>	L <sup>A</sup> T <sub>E</sub> X, Blender, OpenGL, Eigen