

# Brooke Dolny

Computer Graphics Researcher

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## Education

**Candidate for Master's of Mathematics** · University of Waterloo 2024

- Supervised by Prof. Christopher Batty
- Relevant coursework includes numerical methods for partial differential equations, computational linear algebra, physics-based animation.

**Bachelor of Software Engineering** · University of Waterloo 2022

- Graduated with Distinction
- Class academic representative for 3B, 4A, and 4B terms.
- Relevant coursework includes numerical computation, introduction to computer graphics, programming for performance, concurrent and parallel programming.

## Research Experience

**Software Developer Intern** · Autodesk Research May 2022 – Dec 2022 · Sept 2021 – Dec 2021

- Contributed to Autodesk Research's Neon Project for multi-GPU grid-based computations.
- Implemented physics-based simulations for benchmarking and performance evaluation.
- Implemented 2D and 3D GPU-accelerated Lattice-Boltzmann fluid simulations using Neon.
- Generated animations of 2D and 3D lid-driven cavity flow and a 2D Kármán vortex street.
- Implemented a mesh-based finite element solver for linear elasticity.

**Undergraduate Research Assistant** · Institute for Quantum Computing Jan 2021 – Apr 2021

- Implemented a processing pipeline from an EMCCD camera directly to an NVIDIA GPU for image processing and identifying atoms.
- Implemented a library for acquiring and transferring images via GPU Direct.
- Leveraged image processing techniques to identify the location of atoms in an image.
- Implemented Python wrapper libraries to simplify sequences of C API calls for acquiring and transferring images from an EMCCD Camera.
- Developed a mathematical model to generate test data of images of atoms in optical traps based on real image data.

## Teaching Experience

**Concurrency TA** · University of Waterloo Sept 2023 – Dec 2023 · Sept 2024 – Dec 2024

- Teaching assistant for third year concurrent and parallel programming course.
- Topics include coroutines, atomics, locks, semaphores, high-level concurrency structures, shared memory, deadlock, and interprocess communication.
- Graded biweekly assignments while identifying concurrency bugs in the code based on erroneous output and implementation errors.
- Assisted other teaching assistants marking assignments to ensure cohesive grading.

**Computational Linear Algebra TA** · University of Waterloo May 2024 – Aug 2024

- Teaching assistant for a fourth year and graduate level computational linear algebra course.
- Topics include matrix decompositions, direct and indirect methods for solving systems, least squares problems, and eigenvalue decompositions.
- Responded to questions from students on assignment topics and sample problems.

**Numerical Computation TA** · University of Waterloo May 2023 – Aug 2023 · Jan 2024 – Apr 2024

- Teaching assistant for a third year numerical computation computer science course.
- Topics include floating point number systems, splines, numerical solutions to differential equations, and fourier transforms.

- Recorded assignment solution videos with explanations and common mistakes with advice on how to solve the problem.
- Graded over 150 biweekly assignments while coordinating with other teaching assistants.

## Work Experience

### Software Developer Intern · NVIDIA

May 2020 – Aug 2020

- Contributed to the NVIDIA Omniverse Platform's C++ audio processing library.
- Replaced unnecessary busy waiting with semaphores in the audio processing engine.
- Identified and removed concurrency bugs in the codebase.
- Designed and implemented an audio interface containing sound clearing and volume adjustment operations.
- Resolved synchronization issues between Python and C++ audio libraries.

### Software Development Student (Core OS) · BlackBerry

Sept 2019 – Dec 2019

- Developed security solutions for vehicles by integrating Cylance technologies into QNX.
- Designed a consumer-producer system in C++ for processing vehicle messages efficiently.
- Implemented a state machine in C# for identifying a driver based on vehicle data.
- Wrote an asynchronous interface for receiving messages from a gRPC stream.

### Secure Software Developer · ESCRYPT

Jan 2019 – Apr 2019

- Developed secure vehicle to vehicle communication with C++.
- Implemented a parallelized manager for validating the format of messages.
- Identified and resolved race conditions throughout the codebase.
- Modernized C++98 codebase to C++14.

## Projects

### Staggered Grid Linear Elasticity Solver · C++

Nov 2024

- Implemented a finite-difference solver for the linear elasticity equations on a staggered grid.
- Designed a general staggered grid data structure that allows for general Dirichlet and Neumann boundary conditions.
- Derived a volume fraction form of Neumann boundary conditions for linear elasticity using a variational approach.

### Caffeine Symbolic Engine · C++

Apr 2022

- Four-person group collaborative software engineering capstone fourth year design project.
- Implemented a symbolic execution engine that executes a program in LLVM bytecode symbolically and identifies bugs.
- Identifies common bugs such as null pointer dereferences, array index out of bounds, division by zero, and custom user assertions.
- Project is open source and available on Github at [insufficiently-caffeinated/caffeine](https://github.com/insufficiently-caffeinated/caffeine)

### Ray Tracer Animation · C++

Aug 2021

- Computer graphics (CS488) final project animation generated with a ray tracer implemented during the course.
- Implemented a functional ray tracer with time-varying rigid body animation, particle systems.
- Utilized OpenMP to parallelize the ray tracer to improve performance.

## Awards

- President's Scholarship with Distinction · University of Waterloo · 2017.
- Leslie Woo Entrance Scholarship for Women in STEM · University of Waterloo · 2017.

## Interests

Ice Hockey, Biking, Classical Music, Audio and Photo Restoration, Minesweeper