

EDUCATION

Applied Mathematics Ph.D

University of Washington Seattle

 2024 – Present

 GPA: N.A.

Dissertation: N.A.  
Advisor: N.A.

Applied Mathematics M.S.

University of Colorado Boulder

 2020 – 2022

 GPA: 3.863

Thesis: Second-Order Non-Convex Optimization  
Advisor: Stephen Becker

Applied Mathematics B.S.

University of Colorado Boulder

 2017 – 2020

 GPA: 3.933

Minor: Computer Science

- Deep Learning
- Optimization
- Functional Analysis
- Real Analysis
- Complex Analysis
- Differential Eqs.
- Machine Learning
- Linear Algebra
- Probability
- Statistics
- Algorithms
- Numerics
- Algorithmic Economics

WORK & RESEARCH EXPERIENCE

Professional Research Assistant

Aerospace Mechanics Research Center

 May 2022–Sep 2024

 CU, Boulder

- Supervised by Prof. Alireza Doostan and in collaboration with Profs. Stephen Becker, John Evans, and Ken Jansen
- Investigated non-linear compression techniques, such as autoencoding and implicit representation neural networks, for large-scale scientific simulations
- Developed QuadConv, a quadrature-based convolution operator for use in deep learning on non-uniform meshes
- Developed a limited memory sketching-based paradigm for online (in-situ) training of neural compressors
- Working with supercomputer systems through Argonne Leadership Computing Facility (Polaris & Theta) and CU Boulder (Alpine & Blanca)

Development Intern

Electro Magnetic Applications (EMA3D)

 June–Aug 2021

 Denver, CO

- Developed production software for Charge and Cable – electromagnetic simulation tools
- Implemented generalized barycentric interpolation for arbitrary convex polyhedra
- Built post-processing functionality for complex unstructured 3D meshes

Research Assistant

Correll Robotics Lab

 Dec 2018–May 2021

 CU, Boulder

- Aided in the development of nn4mc, a software package which facilitates embedding complex neural networks on microcontrollers
- Investigated methods and tools for embedding complex distributed robotic behaviour through compiled high level primitives

Visiting Research Assistant

University of Southern California: ANRG

 May–Aug 2020

 Remote

- Participated in the Robotics and Autonomous Systems Research Experience for Undergraduates
- Conducted research with professor Bhaskar Krishnamachari on a drift-plus-penalty inspired method for constrained robotic resource collection in a stochastic environment.

TEACHING EXPERIENCE

Various duties which included teaching recitations, running office hours, developing course materials, grading, and more.

Lecturer

Department of Applied Mathematics

 CU, Boulder

- APPM 4720/5720 Applied Deep Learning 1


 Fall 2023

Graduate Teaching Assistant

Department of Applied Mathematics

 CU, Boulder

- APPM 2360 Differential Equations with Linear Algebra

 Fall 2021

## Undergraduate Course Assistant

College of Engineering

📍 CU, Boulder

- APPM 3570 Applied Probability
- CSCI 2360 Computer Science 2: Data Structures
- CSCI 1300 Computer Science 1: Starting Computing

📅 Fall 2019  
 📅 Spring 2019  
 📅 Fall 2018

## PROJECTS & PUBLICATIONS

### Regularized Saddle-Free Newton Independent, Master's Thesis

R-SFN is a novel second-order Newton-type method for non-convex optimization. A non-linear transformation to the Hessian ensures global convergence to second-order stationary points and an efficient matrix-free implementation.

- Cooper Simpson and Stephen Becker. *Regularized Saddle-Free Newton: Saddle Avoidance and Efficient Implementation*. 2023. URL: <https://rs-coop.github.io/projects/research/rsfn>
- Cooper Simpson. "Regularized Saddle-Free Newton: Saddle Avoidance and Efficient Implementation". M.S. Thesis. Dept. of Applied Mathematics, CU Boulder, 2022. URL: <https://rs-coop.github.io/projects/research/rsfn>

### Quadrature-Based Convolutions CU AMReC

QuadConv is a quadrature-based discrete convolution operator for use in training deep neural networks on non-uniform data. For neural compression, we have shown it matches or exceeds the performance of traditional convolution on a grid, and maintains strong results on meshes with non-uniform distributions.

- Kevin Doherty, Cooper Simpson, et al. "QuadConv: Quadrature-Based Convolutions with Applications to Non-Uniform PDE Data Compression". In: *Journal of Computational Physics* (2023). DOI: 10.1016/j.jcp.2023.112636

### Exchange Economy Dynamics Independent

Work towards generalizing the proportional response dynamic to graphical exchange economies with arbitrary network structure and endowments.

- Cooper Simpson. *Generalizing the Proportional Response Dynamic for Exchange Economies*. 2023. URL: <https://rs-coop.github.io/projects/research/prd>

### Neural Networks for Microcontrollers Correll Robotics Lab

Software packages for translating trained neural networks into C code for use in embedded systems.


- S. Aguasvivas, D. Hughes, C. Simpson, et al. "Embedded Neural Networks for Robot Autonomy". In: *Robotics Research*. Cham: Springer International Publishing, 2022, pp. 242–257. DOI: 10.1007/978-3-030-95459-8\_15

## SOFTWARE

 **SFN** Lead  
 A Julia package for non-convex Newton-type optimization algorithms.

 **PyTorch-QuadConv** Co-Lead  
 Quadrature-based convolutions for deep learning in PyTorch.

 **RandNLA** Lead  
 A Julia package for randomized numerical linear algebra.

 **nn4mc** Co-Lead  
 Python and C++ packages for translating trained neural networks into C code for use in embedded systems.


 **PyTorch-ARC** Co-Lead  
 A PyTorch implementation of the Adaptive Regularization with Cubics optimization algorithm.

## AWARDS & CERTIFICATES

 **Wan Fellowship**  
 Prestigious two-year UW Applied Math departmental fellowship.

 **CRA Honorable Mention**  
2020 Computing Research Association Outstanding Undergraduate Researcher.

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 **Solidworks Associate**  
Certified with a perfect score on the CSWA exam in May 2019.

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 **Gateway to Space**  
Received best in option award at spring 2018 ITLL Design Expo for balloon satellite kinetic energy generation experiment.

## SKILLS

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Python PyTorch Julia C++ C# C LaTeX Linux Git HPC CAD

## LANGUAGES

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English: Native  
German: Conversational  
French: Beginner

## REFERENCES

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**Stephen Becker** Associate Professor of Applied Math, CU Boulder  [stephen.becker@colorado.edu](mailto:stephen.becker@colorado.edu)

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**Alireza Doostan** Associate Professor of Aerospace Engineering, CU Boulder  [doostan@colorado.edu](mailto:doostan@colorado.edu)

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**Rafael Frongillo** Associate Professor of Computer Science, CU Boulder  [raf@colorado.edu](mailto:raf@colorado.edu)