# **COOPER SIMPSON**

**Computational and Mathematical Scientist** 





### **EDUCATION**

# Applied Mathematics M.S.

#### **University of Colorado Boulder**

**2020 - 2022** 

GPA: 3.863

Thesis: Second-Order Optimization

# Applied Mathematics B.S.

#### **University of Colorado Boulder**

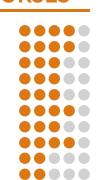
**2017 - 2020** 

GPA: 3.933

Minor: Computer Science

# **SKILLS & COURSES**

Python
Julia
C++/C#/C
Linux
Git
PyTorch
HPC
LaTex
CAD
German



Deep Learning Numerics Analysis

Differential Eqs. Machine Learning

Linear Algebra | Optimization

Probability Statistics Algorithms

Algorithmic Economics

# **ACHIEVEMENTS**



### Solidworks Associate

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



#### **CRA Honorable Mention**

2020 Computing Research Association Outstanding Undergraduate Researcher.



#### **Gateway to Space**

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

### **WORK EXPERIENCE**

# Temporary Researcher

**Aerospace Mechanics Research Center** 

May 2022-Present

**Q** CU. Boulder

- Investigating large scale compression of PDE simulation data on unstructured meshes
- Developed QuadConv, a quadrature-based discrete convolution operator for use in deep learning

### **Development Intern**

**Electro Magnetic Applications (EMA3D)** 

₩ June-Aug 2021

Oenver, 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** 

m Dec 2018-May 2021

O CU Boulde

- 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

### **Teaching & Course Assistantships**

**College of Engineering** 

₩ Variable through 2021

CU, Boulder

- Ran recitations and held office hours helping to teach students fundamental skills
- Developed course material, and worked with faculty members to maintain an organized and effective teaching environment

Differential Eqs. & Linear Algebra (TA) Calculus 1 (TA) Applied Probability (CA)

Data Structures (CA) Starting Computing (CA)

# **PROJECTS & PUBLICATIONS**

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

Presents a novel second-order method for non-convex optimization dubbed R-SFN. A non-linear transformation to the Hessian provides provable saddle-avoidance and an efficient matrix-free implementation.

• Cooper Simpson. "Regularized Saddle-Free Newton: Saddle Avoidance and Efficient Implementation". M.S. Thesis. Dept. of Applied Mathematics, CU Boulder, 2022

### Quadrature-Based Convolutions CU Research

Introduces a quadrature-based discrete convolution operator suitable for use on spatially unstructured data. We show this operator can match the effectiveness of traditional discrete convolutions for autoencoder based data compression, and it can achieve similar performance when the data exists on an unstructured mesh.

 Kevin Doherty et al. "QCNN: Quadrature Convolutional Neural Network with Application to Unstructured Data Compression". In: arXiv (2022). DOI: 10.48550/ ARXIV.2211.05151

### Neural Networks for Microcontrollers Correll Robotics Lab

A Python package for translating trained neural networks into C code for use in embedded systems.

• S. Aguasvivas 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