COOPER SIMPSON

Computational and Mathematical Scientist

RS-Coop | rs-coop.github.io | Boulder, CO

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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 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 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

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