COOPER SIMPSON

Computational and Mathematical Scientist

RS-Coop   rs-coop.github.io   Google Scholar
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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

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

COURSES

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

SOFTWARE*

.jl RSFN
Julia implementation of R-SFN optimization algorithm

PyTorch-QuadConv
Quadrature-based convolutions for deep learning in PyTorch

PyTorch-ARC
PyTorch implementation of the Adaptive Regularization with Cubics optimization algorithm

CERTIFICATIONS

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

WORK EXPERIENCE*

Temporary Researcher
Aerospace Mechanics Research Center   May 2022–Present   CU, Boulder

- Investigating large-scale compression of PDE simulation data via autoencoding neural networks
- Developed QuadConv, a quadrature-based convolution operator for use in deep learning on unstructured and non-uniform meshes
- Working with multiple 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

Teaching & Course Assistantships
College of Engineering   Variable 2018–2021   CU, Boulder

- Ran recitations and office hours helping to teach students fundamental skills in mathematics
- 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 R-SFN: a novel second-order method for non-convex optimization. A non-linear transformation to the Hessian in Newton's method 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 QuadConv, a quadrature-based discrete convolution operator suitable for non-uniform data. We show it can match the effectiveness of traditional discrete convolutions for autoencoder based data compression, and it can achieve similar performance when the data exists on a non-uniform mesh.

- Kevin Doherty et al. "QuadConv: Quadrature-Based Convolutions with Applications to Non-Uniform PDE 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`

*Visit the links in the header for complete lists.