COOPER SIMPSON

Computational and Mathematical Scientist

 RS-Coop   rs-coop.github.io   Google Scholar
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November 29, 2023

EDUCATION

Applied Mathematics M.S.
University of Colorado Boulder

 2020 – 2022   GPA: 3.863
Advisor: Stephen Becker

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

SOFTWARE*

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

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

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

CERTIFICATIONS

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

WORK & TEACHING EXPERIENCE*

Professional Research Assistant
Aerospace Mechanics Research Center   May 2022–Present   CU, Boulder

- Investigating compression techniques, e.g. autoencoding neural networks, for large-scale scientific simulations
- Developing QuadConv, a quadrature-based convolution operator for use in deep learning on non-uniform meshes
- 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

Teaching & Course Assistantships
College of Engineering   Variable 2018–2023   CU, Boulder

- Taught recitations and ran office hours teaching students fundamental mathematical skills
- Worked independently and with faculty members to develop course materials

Applied Deep Learning (Lecturer) 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, Independent
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
- 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
QuadConv is a quadrature-based discrete convolution operator for use in training deep neural networks on non-uniform data.

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

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, D. Hughes, C. Simpson, et al. "Embedded Neural Networks for Robot Autonomy". In: *Robotics Research*. Cham: Springer International Publishing, 2022

＊Visit the links in the header for complete lists.