

# Derek Onken

<https://derekonken.com/>

*Philomath, Polymath, BS in Math*

W302 Math & Science, Emory University | donken@emory.edu

## CURRENT RESEARCH INTERESTS

I am interested in problems in the interdisciplinary overlap of mathematics, computer science, and statistics. I value using the theory from these fields to develop models for practical applications that mostly fall in the physical and biological realms.

### PDE-based Machine Learning

- Applying partial differential equation (PDE) knowledge to neural networks, specifically higher-order time integration schemes and the Discretize-Optimize approach.
- Using PDE-based neural networks to lower false positives in lung cancer diagnosis
- Developing methods to efficiently train high-dimensional continuous normalizing flows
- Solving high-dimensional multi-agent optimal control problems

## EDUCATION

**Ph.D. in Computer Science & Informatics**, Emory University expected 2021

*Advisor:* Lars Ruthotto

*Research:* Optimal control approaches for designing neural ordinary differential equations

**M.S. in Computer Science**, Emory University 2019

**B.S. in Mathematics and Computer Science**, Honors College, University of Georgia 2015

*Minors:* Physics and Classical Culture

*Honors:* Graduated High Honors with Capstone

*Advisor:* Juan B. Gutierrez

*Research:* Statistical analysis of natality data and the relationships of sex ratio against gestation length and calendar distribution

## COMPUTATIONAL SKILLS

Comfortable in PYTHON, PYTORCH, MATLAB, SQL, JAVA

Familiar with Julia, TENSORFLOW, KERAS, C, C++, R, x86, MPI

## WORK EXPERIENCE

**Data Scientist Intern**, UnitedHealth Group, R&D 2019, 2020

**High Performance Computing Intern**, Air Force Research Labs, UES Inc. 2018

**Teaching Assistant**, Emory University 2016-2018

**Tutor**, UGA Athletic Department 2016

**Undergraduate Researcher**, UGA Mathematics Department 2014

**Piano Teacher** 2013-2014

**Summer League Swim Coach** 2009, 2010

## LEADERSHIP & SERVICE

**External Reviewer** for Mathematical Sciences of Machine Learning Conference 2020

**Member** Emory Society for Industrial and Applied Mathematics (SIAM) 2016-present

**Volunteer** Atlanta Science Festival 2016-2019

**University of Georgia Men's Swimming & Diving Team**

2011-2015

- Captain & NCAA Division I Varsity Athlete
- Competed at the SEC championships
- Qualified and competed at the 2016 U.S. Olympic Trials
- NCAA Academic All-American Honorable Mention 2013, 2014, 2015
- Awarded Dick Bestwick Scholar-Athlete Award, UGA Athletic Dept 2015
- Awarded Ramsey Scholarship for Academic and Athletic Excellence 2014-2015
- Awarded Peter O'Sullivan Hardest Worker Award, UGA Men's Swimming 2014, 2015
- Awarded Alex Patterson Scholar-Athlete Award, UGA Men's Swimming 2014
- College Swim Coaches of America Association Scholar All-American Team 2013-2015

**Student-Athlete Advisory Committee Team Representative**

2014-2015

**HONORS & AWARDS**


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Phi Beta Kappa	2015
UGA Presidential Scholar	2014
UGA Athletic Director's Honor Roll	2012-2015
Southeastern Conference Academic Honor Roll	2012-2015
UGA Dean's List	2012-2015
IBM Thomas J. Watson Memorial Scholarship Recipient	2011-2015
Chartered Property Casualty Underwriter (CPCU) Scholarship Recipient	2011

**PUBLICATIONS**

- 
- D. Onken**, L. Nurbekyan, X. Li, S. W. Fung, S. Osher, L. Ruthotto. A Neural Network Approach Applied to Multi-Agent Optimal Control. [preprint](#) [Submitted]
- D. Onken**, L. Ruthotto. Discretize-Optimize vs. Optimize-Discretize for Time-Series Regression and Continuous Normalizing Flows. [preprint](#) [In Revision]
- D. Onken**, S. W. Fung, X. Li, L. Ruthotto. OT-Flow: Fast and Accurate Continuous Normalizing Flows via Optimal Transport. AAAI Conference on Artificial Intelligence 2021. [paper](#)
- Y. Vigfusson\*, T. Karlsson\*, **D. Onken\***, *et al.* Cell-Phone Traces Reveal Infection-Associated Behavioral Change. Proceedings of the National Academy of Science 2021. [paper](#)

\* denotes co-first authors

**INVITED TALKS**

- 
- D. Onken**. "Efficient and Accurate Discretize-Optimize Approaches for Training Deep Residual Networks" in *SIAM Mathematics of Data Science 2020*, [link](#).

**PEER-REVIEWED POSTER PRESENTATIONS**

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- D. Onken**, S. W. Fung, X. Li, L. Ruthotto. "Normalizing Flows Via Mean Field Games and Hamilton-Jacobi-Bellman Equations" in *SIAM/CAIMS AN2020*, [link](#).
- D. Onken**, R. Jennings, S. Garth, E. Haber, E. Treister, S. Novikov, L. Ruthotto. "Using PDE-Based Neural Networks for Classifying 3-D LDCT Images for Lung Cancer Detection" in *IPAM Deep Learning for Medical Applications 2020*, [link](#).

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**SELECTED PRESENTATIONS & POSTERS**

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Image Classification For Lung Cancer Via Neural Networks Based On Partial Differential Equations, *UnitedHealth Group Intern Presentation*, Aug 2019, talk

PDE-based Neural Networks, *UnitedHealth Group Brown Bag Lecture Series*, Jul 2019, talk

Applying Higher-Order Runge-Kutta Methods To Neural Networks, *Emory Scientific Computing Seminar*, Apr 2019, [talk](#)

Applying Higher-Order Runge-Kutta Methods To Neural Networks, *Georgia Scientific Computing Symposium*, Feb 2019, [poster](#)

Cell Segmentation via Convolutional Neural Networks, *High Performance Computing and Modernization Program*, Aug 2018, poster and talk

Tracking Behavioral Alterations via Cell Phone Data, *Amazon Graduate Research Symposium*, Oct 2017, [poster](#)

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**SELECTED RELEVANT COURSEWORK**

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Coursework at Emory University:

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|--------------------------|--------------------------|-------------------------------|
| – Numerical Optimization | – Data Mining            | – Systems Programming         |
| – Deep Learning Numerics | – Machine Learning       | – Distributed Processing      |
| – Numerical Analysis II  | – Biostatistical Methods | – Database Systems            |
| – Numerical Analysis I   | – Algorithms             | – Computer Security (Hacking) |

Graduate-level coursework at the University of Georgia:

- |                     |              |                        |
|---------------------|--------------|------------------------|
| – Bivariate Splines | – Automata   | – Software Engineering |
| – Complex Analysis  | – Algorithms | – Thermodynamics       |