Samy Wu Fung

✉ *swufung@mines.edu*
swufung.githhub.io

Appointments

- Assistant Professor. Department of Applied Mathematics and Statistics. Colorado School of Mines. August 2021 - present
- Assistant Adjunct Professor. Department of Mathematics, University of California, Los Angeles. July 2019 - August 2021
- Givens Associate. MCS Division, Argonne National Laboratory. May 15, 2018 - Nov 30, 2018

Education

- PhD. in Applied Mathematics, Emory University, Atlanta, GA, May 2019
  Advisor: Lars Ruthotto
- BSc. in Applied Mathematics, Brown University, Providence, RI, May 2014
  Advisor: Johnny Guzmán
- AA. in Mathematics, Miami Dade College, Miami, FL, May 2011

Research Interests

- Inverse Problems, Deep Learning, Optimization, Optimal Control, Mean Field Games

Preprints/Submitted Articles

1. Heaton H, Wu Fung S, Osher S. Global Solutions to Nonconvex Problems by Evolution of Hamilton-Jacobi PDEs, 2202.11014
2. Ye J[†], Wan C[†], Wu Fung S. Adaptive Uncertainty-Weighted ADMM for Distributed Optimization, arXiv:2109.01089
3. Heaton H, McKenzie D, Li Q, Wu Fung S, Osher S, Yin W. Learn to Predict Equilibra via Fixed Point Networks, 2106.00906

Published/Accepted Articles

1. Onken D, Nurbekyan L, Li X, Wu Fung S, Osher S, Ruthotto L. A Neural Network Approach for High-Dimensional Optimal Control, *Transactions on Control Systems Technology*, accepted, 2022

[†]undergraduate student at time of publication

2. Heaton H*, Wu Fung S*, Lin AT*, Osher S, Yin W. Wasserstein-based Projections with Applications to Inverse Problems, *SIAM Journal on Mathematics of Data Science*, accepted, 2022.

3. Wu Fung S*, Heaton H*, McKenzie D, Li Q, Osher S, Yin W. JFB: Jacobian-free Backpropagation for Implicit Networks, *AAAI Conference on Artificial Intelligence*, accepted, 2022

4. Heaton H*, Wu Fung S*, Gibali A, Yin W. Feasibility-based Fixed Point Networks, *Fixed Point Theory and Algorithms for Sciences and Engineering*, 21, 2021

5. Kan K, Wu Fung S, Ruthotto L. PNKH-B: A Projected Newton-Krylov Method for Large-Scale Bound-Constrained Optimization, *SIAM Journal on Scientific Computing*, 43(5), S704–S726, 2021

6. Lin AT*, Wu Fung S*, Li W, Nurbekyan L, Osher S. Alternating the Population and Agent Control via Two Neural Networks to Solve High-Dimensional Stochastic Mean Field Games, *Proceedings of the National Academy of Sciences*, 118(31). 2021

7. Onken D, Nurbekyan L, Li X, Wu Fung S, Osher S, Ruthotto L. A Neural Network Approach Applied to Multi-Agent Optimal Control, *European Control Conference 2021 (ECC21*, accepted. 2021

8. Onken D, Wu Fung S, Li X, Ruthotto L. OT-Flow: Fast and Accurate Continuous Normalizing Flows via Optimal Transport, *AAAI Conference on Artificial Intelligence*, 35(10), 9223-9232, 2021

9. Ruthotto L, Osher S, Li W, Nurbekyan L, Wu Fung S. A Machine Learning Framework for Solving High-Dimensional Mean Field Game and Mean Field Control Problems, *Proceedings of the National Academy of Sciences*, 117(17), 2019-22204, 2020 †

10. Wu Fung S, Tyrväinen S, Ruthotto L, Haber E. ADMM-Softmax: An ADMM Approach for Multinomial Logistic Regression, *Electronic Transactions on Numerical Analysis*, 52, 214-229, 2020

11. Wu Fung S, Di Z. Multigrid Optimization for Large-Scale Ptychographic Phase Retrieval, *SIAM Journal on Imaging Sciences*, 13(1), 214–233. 2020

12. Wu Fung S, Ruthotto L. An Uncertainty-Weighted Asynchronous ADMM Method for Large-Scale PDE Parameter Estimation, *SIAM Journal on Scientific Computing*, 41(5),S129-S148, 2019

13. Wu Fung S, Ruthotto L. A Multiscale Method for Model Order Reduction in PDE Parameter Estimation, *Journal of Computational and Applied Mathematics*, 350, 19-34, 2019

*denotes co-first author

†Author contributions: L.R., S.J.O., W.L., L.N., and S.W.F. designed research; L.R., L.N., and S.W.F. performed research; and L.R., S.J.O., W.L., L.N., and S.W.F. wrote the paper.

Contributed and Invited Research Presentations

- *A Deep Learning Approach for Real-Time High-Dimensional Optimal Control*
  - invited talk at the Center for Research in Signals and Networks Seminar, Colorado School of Mines. February 18, **2022**.
  - invited talk at the Hamilton-Jacobi PDEs Reunion Conference I, at the Institute for Pure and Applied Mathematics, Los Angeles, California, January 13, **2022**.
- *Efficient Training and Design of Implicit Networks with Applications in Contextual Games*
  - invited talk at the Center for Research in Signals and Networks Seminar, Colorado School of Mines. December 10, **2021**.
- *Efficient Training of Infinite-depth Neural Networks via Jacobian-free Backpropagation*
  - invited talk at the Los Alamos National Lab ML Seminar, February 17, **2022**.
  - invited talk at the The Carl Heiland Lecture Series, at the Department of Geophysics, Colorado School of Mines, February 9, **2022**.
  - invited talk at the Applied Math/Inverse Problems Seminar, at Colorado State University, February 3, **2022**.
  - invited talk at the The Scientific AI Research Group, at the University of Texas at Austin, January 28, **2022**.
  - invited talk at the AMS Fall Western Sectional Meeting, at University of New Mexico. October 23, **2021**.
  - invited talk at the PDE and Applied Math Seminar at the University of California, Riverside. October 20, **2021**.
  - invited talk at the Statistics, Optimization and Machine Learning Seminar at University of Colorado, Boulder. October 12, **2021**.
  - contributed talk at the Applied Math and Statistics Colloquium at Colorado School of Mines. September 10, **2021**.
- *Wasserstein-based Projections for Inverse Problems*
  - invited talk at the Applied and Computational Mathematics Seminar at Dartmouth College. January 26, **2021**.
  - invited talk at the PDE and Applied Math Seminar at the University of California, Riverside. January 20, **2021**.
  - invited talk at the Deep Learning Seminar at University of South Carolina. December 1, **2020**.
  - invited talk at the Optimal Transport and Mean Field Game Seminar at University of South Carolina. October 14, **2020**.
  - invited talk at the Mathematics and Deep Learning Collective at Iowa State University. October 2, **2020**.
- *A GAN-based Approach for High-Dimensional Stochastic Mean Field Games*, held at

- invited talk at the SIAM Virtual Conference on Mathematics of Data Science. June 25, **2020**
- invited talk at the Laboratory for Applied Mathematics, Numerical Software, and Statistics (LANS) Seminar at Argonne National Laboratory. June 17, **2020**.
- invited talk at the Numerical Analysis and Scientific Computing Seminar at Emory University. Atlanta, Ga. March 27, **2020**.

- *A Machine Learning Framework for High-Dimensional Mean Field Games*, held at
  - invited talk at the Optimal Transport and Applications to Machine Learning and Statistics workshop at MSRI, Berkeley, Ca, May 5, **2020** (Online Recording)
  - invited talk (joint with Stanley Osher) at the High Dimensional Hamilton-Jacobi Methods in Control and Differential Games workshop at IPAM, Los Angeles, Ca, April 1, **2020** (Online Recording)
  - contributed poster in the Intersections between Control, Learning and Optimization workshop at IPAM, Los Angeles, Ca, February 24, **2020**
  - invited talk at the Level Set Collective Seminar, Department of Mathematics, UCLA, Los Angeles, Ca. December 3, **2019**
- *Adaptive Multiscale and Asynchronous Optimization Methods for Large-Scale PDE Parameter Estimation*, held at
  - invited talk at the Level Set Collective Seminar, Department of Mathematics, UCLA, Los Angeles, Ca. July 30, **2019**
  - invited talk at AMS Spring Southeastern Sectional Meeting, Auburn, AL, March 17, **2019**
  - invited talk at SIAM Conference on Computational Science and Engineering, Spokane, Wa. February 27, **2019**.
- *Large-Scale Classification using Multinomial Regression and ADMM*
  - contributed poster at Georgia Scientific Computing Symposium. Atlanta, Ga. February 16, **2019**
- *Multilevel Algorithms for Ptychographic Phase Retrieval*, held at various occasions:
  - contributed talk at the Summer Argonne Student Symposium at Argonne National Laboratory. Lemont, Il. July 26, **2018**
  - invited talk at the Advanced Photon Source at Argonne National Laboratory. Lemont, Il. July 16, **2018**
- *An Uncertainty-Weighted ADMM Method for Large-Scale PDE Parameter Estimation*, held at various occasions:
  - invited talk at SIAM Conference on Uncertainty Quantification. Garden Grove, Ca. April 19, **2018**
  - contributed talk at Fifteen Copper Mountain Conference on Iterative Methods. Copper Mountain, Co. March 26, 2018

- invited talk at Spelman College. Atlanta, Ga, February 26, **2018**
- contributed poster at Georgia Scientific Computing Symposium. Atlanta, Ga. February 24, **2018**
- contributed talk at the Scientific Computing Seminar at Emory University. Atlanta, Ga, USA, October 13, **2017**

- *jInv - A Flexible Julia Package for Parallel PDE Parameter Estimation*, held at various occasions:
  - contributed e-poster at SIAM Conference on Computer Science and Engineering, Atlanta, GA, March 1, **2017**
  - contributed poster, Georgia Scientific Computing Symposium. Atlanta, Ga. February 20, 2016
- *PDE-Constrained Optimization with Multiscale Methods*, held at various occasions:
  - invited talk at SIAM Annual Meeting Conference. Pittsburgh, Pa, USA. July 10 - 14, **2017**
  - invited talk at SIAM Conference on Computational Science and Engineering. Atlanta, Ga, USA, March 3, **2017**
  - contributed talk at the Scientific Computing Seminar at Emory University. Atlanta, Ga, USA, February 17, **2017**

Teaching

- Spring 2022
  - MATH 307: Intro to Scientific Computing, Section A, Colorado School of Mines
- Fall 2021
  - MATH 307: Intro to Scientific Computing, Section A, Colorado School of Mines
  - CSCI 499: Independent Study
- Spring 2021
  - MATH199: Directed Research in Mathematics, Section 9, UCLA (**online**)
  - MATH 151A: Applied Numerical Methods I, Sections 1 & 2 , UCLA (**online**)
- Winter 2021
  - MATH 270C: Computational Linear Algebra (Graduate Level), Section 1, UCLA (**online**)
- Fall 2020
  - MATH 151B: Applied Numerical Methods II, Section 1, UCLA (**online**)
- Spring 2020
  - MATH 151A: Applied Numerical Methods I, Sections 1 & 2 , UCLA (**online**)

- Winter 2020
  - MATH 151B: Applied Numerical Methods II, Section 1, UCLA
- Fall 2019
  - MATH 151A: Applied Numerical Methods I, Section 3, UCLA
- Fall 2016
  - MATH 111: Introductory Calculus, Emory University
- Spring 2016
  - MATH 111: Introductory Calculus, Emory University
- Fall 2015
  - MATH 111: Introductory Calculus, Emory University
- Spring 2015
  - MATH 351: Partial Differential Equations, Emory University (TA)
- Fall 2014
  - MATH 212: Ordinary Differential Equations, Emory University (TA)

Mentoring

- Undergraduate Student Supervision
  - Ibrohim Nosirov. Project: *Deep Learning Methods for Signal Processing*. Colorado School of Mines, September 2021 - Present. Co-advised with Mike Wakin
  - Sudhanshu Agrawal. Project: *Machine Learning for High-Dimensional Non-Local Mean Field Games*. UCLA, January 2020 - Present. Co-advised with Levon Nurbekyan
  - Richard Yim. Project: *Learned Inverse Scale Space Flows*. UCLA, January 2020 - June 2020.
  - Caleb Wan and Jiangping Ye. Project: *Adaptive Uncertainty-Weighted ADMM Methods for Machine Learning*. UCLA, July 2020 - Present.
- Research in Industrial Projects for Students (RIPS). Institute for Pure and Applied Mathematics, UCLA. June 2020 - Aug 2020. Project: *Large-Scale Inventory Optimization*
  - Miranda Kaiser, Rensselaer Polytechnic Institute
  - Julia Balukonis, Providence College
  - Rachel Fan, Vanderbilt University
  - Rong (Hugh) Jiang, UC Berkeley
- Graduate Student Supervision

- Michael Ivanitsky (1st year PhD student at Colorado School of Mines). Project: Reinforcement Learning Informed by Biological Processes. Co-advised with Cecilia Diniz-Behn.
- Soraya Terrab (3rd year PhD student at Colorado School of Mines). Project: Data-Driven Multiwavelet Methods for Discontinuity Detection. Co-advised with Jennifer Ryan.

Other Skills

- Programming Languages: Python, Julia, Matlab
- Languages: Spanish (native), English (fluent), French (fluent), Cantonese (fluent)

Workshop and Minisymposium Organization

- Co-organizer of mini-symposium on *Deep Learning Methods for Optimization* at SIAM Conference on Uncertainty Quantification, Atlanta, Ga, USA. April 2022
- Co-organizer of mini-symposium on *Advances in Regularization Techniques for Ill-Posed Problems* at the SIAM Conference on Imaging Sciences, Toronto, Canada. July, 2020
- Co-organizer of mini-symposium on *Advances in Optimal Control for and with Machine Learning* at the SIAM Conference on Mathematics of Data Science, Cincinnati, Ohio. May, 2020
- Co-organizer of mini-symposium on *Mathematical Advances in Deep Learning* at the SIAM Conference on Computational Science and Engineering, Spokane, Washington. February, 2019

Professional Activities and Affiliations

- Reviewer for the following journals and conferences:
  - SIAM Journal on Scientific Computing
  - SIAM Journal on Imaging Sciences
  - Frontiers in Applied Mathematics and Statistics
  - Mathematical and Scientific Machine Learning Conference (MSML)
  - Journal of Applied and Numerical Optimization (JANO)
- Board Member for the Emory SIAM Student Chapter. Aug 2014 - May 2019
- Member of the Brown University Immigrant Rights Coalition. Aug 2011 - May 2014
- Member of Students Working for Equal Rights. Aug 2009 - May 2011

Honors and Awards

- 2022 MGB-SIAM Early Career (MSEC) Fellowship

  - Award in recognition of the achievements of early career applied mathematicians, particularly those from underrepresented communities

- 2021 Open Access Mini Grant Award, Colorado School of Mines
  - Award to help cover article processing charges.
- 2019 Emory Graduate Student Research Award
  - awarded annually to select few Ph.D. students in recognition of outstanding research
- Brown University Dean's Grant. 06/2013 – 07/2013
- Second Place Team Placement: 2011 Florida State Math Olympics
  - yearly math competition among community colleges in Florida
- 2010 Miami Dade Honors Convocation Award in Economics
  - awarded annually to one student across the entire college