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. Ye J[†], Wan C[†], Wu Fung S. Adaptive Uncertainty-Weighted ADMM for Distributed Optimization, arXiv:2109.01089
2. Heaton H, McKenzie D, Li Q, Wu Fung S, Osher S, Yin W. Learning to Predict Equilibra via Fixed Point Networks.
3. Onken D, Nurbekyan L, Li X, Wu Fung S, Osher S, Ruthotto L. A Neural Network Approach for High-Dimensional Optimal Control, arXiv:2104.03270, 2021
4. Wu Fung S*, Heaton H*, McKenzie D, Li Q, Osher S, Yin W. JFB: Jacobian-free Backpropagation for Implicit Networks, arXiv:2008.02200, 2021
5. Heaton H*, Wu Fung S*, Lin AT*, Osher S, Yin W. Wasserstein-based Projections with Applications to Inverse Problems, arXiv:2008.02200, 2020

[†]undergraduate student at time of publication

Published/Accepted Articles

1. 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

2. 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

3. 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

4. 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

5. 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

6. 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 †

7. 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

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

9. 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

10. 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

Contributed and Invited Research Presentations

- *Efficient Training of Infinite-depth Neural Networks via Jacobian-free Backpropagation*
  - 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.

*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.

- 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

- Fall 2021

- MATH 307: Intro to Scientific Computing, Section A, Colorado School of Mines
- CSCI 499: Indendent 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

- 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