Jonathan W. Siegel

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EDUCATION

University of California at Los Angeles 2013-2018
Ph.D. in Mathematics Los Angeles, CA
Advisor: Russel E. Caflish
Thesis: "Accelerated First-Order Optimization with Orthogonality Constraints"

University of California at Santa Cruz 2009-2013
B.Sc. (Honors) in Mathematics Santa Cruz, CA

ACADEMIC APPOINTMENTS

Assistant Professor 2022-present
Texas A&M University College Station, TX

Assistant Research Professor 2021-2022
Pennsylvania State University University Park, PA

Postdoctoral Scholar 2018-2021
Pennsylvania State University University Park, PA

RESEARCH PAPERS

Published

- The Extended Regularized Dual Averaging Method for Composite Optimization. *to appear in Journal of Computational Mathematics.* With Jinchao Xu.
  Preprint available at: https://arxiv.org/abs/1904.02316
- Sharp Bounds on the Approximation Rates, Metric Entropy, and n-widths of Shallow Neural Networks. *Foundations of Computational Mathematics* 1-57, 2022. With Jinchao Xu.
  Preprint available at: https://arxiv.org/abs/2101.12365
- Characterization of the Variation Spaces Corresponding to Shallow Neural Networks. *to appear in Constructive Approximation.* With Jinchao Xu.
  Preprint available at: https://arxiv.org/abs/2106.15002
- Uniform Approximation Rates and Metric Entropy of Shallow Neural Networks. *Research in the*

Mathematical Sciences 9.3:1-21, 2022. With Limin Ma and Jinchao Xu.

- Optimal Convergence Rates for the Orthogonal Greedy Algorithm. *IEEE Transactions on Information Theory* 68.5:3354-3361, 2022. With Jinchao Xu.
- Extensible Structure-Informed Prediction of Formation Energy with Improved Accuracy and Usability employing Neural Networks. *Computational Materials Science* 208:111254, 2021. With Adam Krajewski, Zi-Kui Liu, and Jinchao Xu.
- High-Order Approximation Rates for Shallow Neural Networks with Cosine and ReLU^k Activation Functions. *Computational and Applied Harmonic Analysis* 58:1-26, 2022. With Jinchao Xu.
- Approximation rates for neural networks with general activation functions. *Neural Networks* 128:313-321, 2020. With Jinchao Xu.
- Accuracy, Efficiency and Optimization of Signal Fragmentation. *Multiscale Modeling and Simulation* 18(2):737–757, 2020. With Russel Caflisch and Hung Hsu Chou
- Accelerated Optimization with Orthogonality Constraints. *Journal of Computational Mathematics* 39(2):207–226, 2020.
- Compact Support of L^1 Penalized Variational Problems. *Communications in Mathematical Sciences* 15(6):1771-1790, 2017. With Omer Tekin.

After First Revision

- Greedy Training Algorithms for Neural Networks and Applications to PDEs. *First Revision submitted to Journal of Computational Physics*, 2022. With Qingguo Hong, Xianlin Jin, Wenrui Hao, and Jinchao Xu.
  Preprint available at: https://arxiv.org/abs/2107.04466

Under Review

- Sharp Lower Bounds on Interpolation by Deep ReLU Neural Networks at Irregularly Spaced Data. *Submitted to Machine Learning*, 2023.
  Preprint available at: https://arxiv.org/abs/2302.00834
- Optimal Approximation Rates for Deep ReLU Neural Networks on Sobolev Spaces. *Submitted to Journal of Machine Learning Research*, 2023.
  Preprint available at: https://arxiv.org/abs/2211.14400
- Training Sparse Neural Networks using Compressed Sensing. *Submitted to IEEE Transactions on Neural Networks and Learning Systems*, 2021. With Jianhong Chen, Pengchuan Zhang and Jinchao Xu.
  Preprint available at: https://arxiv.org/abs/2008.09661
- Accelerated First-Order Methods: Differential Equations and Lyapunov Functions. *Submitted to Journal of Computational Mathematics*, 2021.
  Preprint available at: https://arxiv.org/abs/1903.05671

- On the Activation Function Dependence of the Spectral Bias of Neural Networks. *Submitted to ICLR*, 2023. With Qingguo Hong, Qingyang Tan and Jinchao Xu

GRANTS

Penn State Institute for CyberScience Seed Grant (co-PI) 2018-2019
"Deep Learning for CALPHAD Database Development and Uncertainty Quantification" $35,000

NSF DMS-2111387 (co-PI) 2021-2024
"Comparative Study of Finite Element and Neural Networks Discretizations for Partial Differential Equations" $550,000

NSF DMS-2216799 (PI) 2022
"US Participation at the Twenty-sixth International Domain Decomposition Conference" $15,000

NSF CCF-2205004 (co-PI) 2022-2025
"CIF: Small: Interpretable Machine Learning based on Deep Neural Networks: A Source Coding Perspective" $600,000

TEACHING EXPERIENCE

Texas A&M University Fall 2022
Instructor College Station, TX
Math 308H - Honors Differential Equations

Pennsylvania State University Fall 2021
Instructor University Park, PA
Math 141 - Integral Calculus

Pennsylvania State University Spring 2021
Co-Instructor University Park, PA
Math 555 - Optimization Theory (Graduate Course)

Pennsylvania State University Fall 2020
Instructor University Park, PA
Math 140 - Differential Calculus

Pennsylvania State University Spring 2020
Instructor University Park, PA
Math 251 - Differential Equations
Math 251H - Honors Differential Equations

Pennsylvania State University Fall 2019
Instructor University Park, PA
Math 141 - Integral Calculus

Pennsylvania State University/Peking University Summer 2019
Co-Instructor Beijing, China
Math 497 - Introduction to Deep Learning

Pennsylvania State University Fall 2018
Instructor University Park, PA
Math 141 - Integral Calculus

University of California, Los Angeles 2014-2017
Teaching Assistant Los Angeles, CA
Math 32B - Integral Vector Calculus
Math 32A - Differential Vector Calculus
Math 110B - Finite Group Theory

INVITED SEMINAR AND CONFERENCE TALKS

SUNY Albany January 23, 2023
Data Science Seminar

Brown University December 23, 2022
Crunch Seminar on Scientific Computing

Texas A&M University December 8, 2022
TAMIDS Seminar

University of Oslo December 1, 2022
Scientific and Machine Learning Seminar

King Abdullah University of Science and Technology (KAUST) November 22, 2022
Mathematics and Computational Science Seminar

King Abdullah University of Science and Technology (KAUST) November 15, 2022
Conference on Scientific Computing and Machine Learning

Texas State University September 30, 2022
SyDATA Symposium

Texas A&M University August 31, 2022
CAMDA Seminar

Czech Technical University in Prague July 26, 2022
27th International Conference on Domain Decomposition Methods, Invited Plenary Talk

Princeton University May 16, 2022
Wilks Seminar

Georgia Institute of Technology April 4, 2022
Applied and Computational Mathematics (ACM) Seminar

Illinois Institute of Technology January 21, 2022
Mathematics Department Colloquium

Texas A&M University December 6, 2021
Mathematics Department Colloquium

University of South Carolina November 29, 2021
Mathematics Department Colloquium

Rensselaer Polytechnic Institute October 6, 2021
Mathematics in Imaging, Data and Optimization Seminar

RWTH Aachen October 4, 2021
Applied Mathematics Group Lunch Seminar

ETH Zurich June 2, 2021
FoMICS Seminar Talk and Lecture

University of Texas, Austin May 21, 2021
Applied Mathematics Seminar

University of California, San Diego May 11, 2021
CCoM Seminar

Purdue University May 10, 2021
Mathematical Data Science Webinar

University of Notre Dame April 15, 2021
ACMS Applied Mathematics Seminar

University of California, Irvine March 15, 2021
Computational Mathematics Seminar

California Institute of Technology February 17, 2021
CMX (Computational Mathematics) Seminar

Pennsylvania State University December 15, 2020
CCMA Workshop on Mathematical Machine Learning and Applications

INVITED MINI-SYMPOSIUM TALKS

SIAM Conference on the Mathematics of Data Science September 27, 2022
Recent Advances in Machine Learning and Optimization

SIAM Conference on Uncertainty Quantification April 12, 2022
Recent Advances in Machine Learning and Data-Driven Methods for Physical Sciences and Engineering

AMS Fall Western Sectional Meeting October 23, 2021
Special Session on Theoretical and Applied perspectives in Machine Learning

SIAM Conference on Analysis of PDEs March 16, 2021
Mathematics of Machine Learning Methods for PDEs

Kunming, China August 15, 2019
International Multigrid Conference (IMG)

SERVICE

Students Co-Advised

- Jianhong Chen, Penn State Graduate Student, 2019-2020
- Xianlin Jin, Peking University Graduate student, 2021-present

Conferences Co-Organized

- CCMA Workshop on Mathematical Machine Learning and Applications, December 14-16, 2020.

Seminars Co-Organized

- Computational and Applied Mathematics (CAM) Colloquium at Penn State, Fall 2020-Fall 2021

Ad-Hoc Reviewer for

- Mathematical Programming, Neural Networks, AISTATS, Numerical Algorithms, Calculus of Variations and Partial Differential Equations, Expert Systems with Applications, IEEE Transactions on Neural Networks and Learning Systems, SIAM Journal on Optimization, Journal of Machine Learning Research, SIAM Journal on Mathematics of Data Science, SIAM Journal on Numerical Analysis

AWARDS AND SCHOLARSHIPS

University of California, Los Angeles 2018
- Pacific Journal of Mathematics Dissertation Award

University of California, Los Angeles 2013-2014
- University of California Regents Fellow

University of California, Santa Cruz 2012

- Stephen M. Palais Award

University of California, Santa Cruz 2011

- Putnam Mathematical Competition Honorable Mention

AFFILIATIONS

American Mathematical Association (AMS) 2021-present
Society of Industrial and Applied Mathematicians (SIAM) 2021-present

INDUSTRY EXPERIENCE

Google Intern June 6, 2016-August 26, 2016

Mountainview, CA

I worked with the Network Architecture team on improving the efficiency of a Monte Carlo network reliability simulation. Specifically, I implemented importance sampling, which reduced the number of samples required by a factor of 3.

Google Intern June 12, 2017-September 1, 2017

Los Angeles, CA

I worked with the Budgetplanner Team (a division working on advertisement). I built a data processing pipeline that collected and processed data which was scattered across multiple relational databases to create training data for a machine learning model. Then I used TensorFlow to design and test multiple machine learning models on the resulting dataset.

TECHNICAL STRENGTHS

Programming Skills: C/C++, Java, Matlab, Latex, Python