

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

- 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

- Sharp Bounds on the Approximation Rates, Metric Entropy, and n -widths of Shallow Neural Networks. *First Revision Submitted to Foundations of Computational Mathematics*, 2022. With Jinchao Xu.
Preprint available at: <https://arxiv.org/abs/2101.12365>
- Training Sparse Neural Networks using Compressed Sensing. *First Revision 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>
- The Extended Regularized Dual Averaging Method for Composite Optimization. *First Revision Submitted to Journal of Computational Mathematics*, 2021. With Jinchao Xu.
Preprint available at: <https://arxiv.org/abs/1904.02316>

Under Review

- Greedy Training Algorithms for Neural Networks and Applications to PDEs. *Submitted to Journal of Computational Physics*, 2021. With Qingguo Hong, Xianlin Jin, Wenrui Hao, and Jinchao Xu.
Preprint available at: <https://arxiv.org/abs/2107.04466>
- 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 NeurIPS*, 2022. 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

Pennsylvania State University	Fall 2021
<i>Instructor</i>	University Park, PA
Math 141 - Integral Calculus	
Pennsylvania State University	Spring 2021
<i>Co-Instructor</i>	University Park, PA
Math 555 - Optimization Theory (Graduate Course)	
Pennsylvania State University	Fall 2020
<i>Instructor</i>	University Park, PA
Math 140 - Differential Calculus	
Pennsylvania State University	Spring 2020
<i>Instructor</i>	University Park, PA
Math 251 - Differential Equations	
Math 251H - Honors Differential Equations	
Pennsylvania State University	Fall 2019
<i>Instructor</i>	University Park, PA
Math 141 - Integral Calculus	
Pennsylvania State University/Peking University	Summer 2019
<i>Co-Instructor</i>	Beijing, China
Math 497 - Introduction to Deep Learning	
Pennsylvania State University	Fall 2018
<i>Instructor</i>	University Park, PA

Math 141 - Integral Calculus

University of California, Los Angeles

Teaching Assistant

Math 32B - Integral Vector Calculus

Math 32A - Differential Vector Calculus

Math 110B - Finite Group Theory

2014-2017

Los Angeles, CA

INVITED SEMINAR AND CONFERENCE TALKS

Texas A&M University

CAMDA Seminar

August 31, 2022

Czech Technical University in Prague

27th International Conference on Domain Decomposition Methods, Invited Plenary Talk

July 26, 2022

Princeton University

Wilks Seminar

May 16, 2022

Georgia Institute of Technology

Applied and Computational Mathematics (ACM) Seminar

April 4, 2022

Illinois Institute of Technology

Mathematics Department Colloquium

January 21, 2022

Texas A&M University

Mathematics Department Colloquium

December 6, 2021

University of South Carolina

Mathematics Department Colloquium

November 29, 2021

Rensselaer Polytechnic Institute

Mathematics in Imaging, Data and Optimization Seminar

October 6, 2021

RWTH Aachen

Applied Mathematics Group Lunch Seminar

October 4, 2021

ETH Zurich

FoMICS Seminar Talk and Lecture

June 2, 2021

University of Texas, Austin

Applied Mathematics Seminar

May 21, 2021

University of California, San Diego

CCoM Seminar

May 11, 2021

Purdue University <i>Mathematical Data Science Webinar</i>	May 10, 2021
University of Notre Dame <i>ACMS Applied Mathematics Seminar</i>	April 15, 2021
University of California, Irvine <i>Computational Mathematics Seminar</i>	March 15, 2021
California Institute of Technology <i>CMX (Computational Mathematics) Seminar</i>	February 17, 2021
Pennsylvania State University <i>CCMA Workshop on Mathematical Machine Learning and Applications</i>	December 15, 2020

INVITED MINI-SYMPOSIUM TALKS

Kunming, China <i>International Multigrid Conference (IMG)</i>	August 15, 2019
AMS Fall Western Sectional Meeting <i>Special Session on Theoretical and Applied perspectives in Machine Learning</i>	October 23, 2021
SIAM Conference on Analysis of PDEs <i>Mathematics of Machine Learning Methods for PDEs</i>	March 16, 2021
SIAM Conference on Uncertainty Quantification <i>Recent Advances in Machine Learning and Data-Driven Methods for Physical Sciences and Engineering</i>	April 12, 2022

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