HANCHENG MIN

Postdoctoral Researcher ⋄ Center for Innovation in Data Engineering and Science (IDEAS)
Electrical and Systems Engineering ⋄ University of Pennsylvania
Email: hanchmin@seas.upenn.edu ⋄ **Web**: https://hanchmin.github.io/

Research Interests: Deep Learning Theory; Mathematical Foundations for Trustworthy AI; Dynamical Systems

EDUCATION

Johns Hopkins University, Baltimore, MD — *Sep. 2018 – Jul. 2023*
Ph.D., Electrical and Computer Engineering

University of Pennsylvania, Philadelphia, PA — *Sep. 2016 – May. 2018*
Master of Science in Engineering, Electrical and Systems Engineering

Tongji University, Shanghai, China — *Sep. 2012 – Jul. 2016*
Bachelor of Engineering, Automation

ACADEMIC APPOINTMENT

Postdoctoral Researcher — *Aug. 2023 – Jul. 2025*
Vidal-lab, University of Pennsylvania;
Advisor: René Vidal

Graduate Research Assistant — *Sep. 2018 – Jul. 2023*
NetD-lab, Johns Hopkins University;
Primary Advisor: Enrique Mallada; *Co-advisor*: René Vidal

Graduate Research Assistant — *Jun. 2017 – May. 2018*
Kod*lab, University of Pennsylvania;
Mentor: Ömür Arslan

PUBLICATIONS

Preprint

[P3] **H. Min**, L. E. MacDonald, and R. Vidal, "Gradient descent in deep learning: Convergence, implicit bias, and edge of stability," **under review** for *IEEE Signal Processing Magazine, Special Issue on Mathematics of Deep Learning*.

[P2] **H. Min** and R. Vidal, "Understanding incremental learning with closed-form solution to gradient flow on overparamerterized matrix factorization," **under review** for *IEEE Conference on Decision and Control (**CDC**)* 2025.

[P1] **H. Min**, S. Tarmoun, R. Vidal, and E. Mallada, "Convergence and implicit bias of gradient flow on overparametrized linear networks," 2023, arXiv:2105.06351.

Journal

[J5] **H. Min**, R. Pates, and E. Mallada, "A frequency domain analysis of slow coherency in networked systems," *Automatica*, vol. 174, p. 112 184, 2025.

[J4] Z. Xu, **H. Min**, S. Tarmoun, E. Mallada, and R. Vidal, "A local polyak-łojasiewicz and descent lemma of gradient descent for overparameterized linear models," *Transactions on Machine Learning Research (**TMLR**)*, 2025, to appear.

[J3] Y. Jiang, **H. Min**, and B. Zhang, "Oscillations-aware frequency security assessment via efficient worst-case frequency nadir computation," *Electric Power Systems Research (**EPSR**)*, vol. 234, pp. 110 656–110 664, 2024, also in PSCC 2024.

[J2] A. Castellano, **H. Min**, J. A. Bazerque, and E. Mallada, "Learning to act safely with limited exposure and almost sure certainty," *IEEE Transaction on Automatic Control (**TAC**)*, vol. 68, no. 5, pp. 2979–2994, May 2023.

[J1] **H. Min**, F. Paganini, and E. Mallada, "Accurate reduced order models for coherent heterogeneous generators," *IEEE Control Systems Letters (**L-CSS**)*, vol. 5, no. 5, pp. 1741–1746, Nov. 2021, also in ACC 2021.

Conference

[C17] J. Luo, T. Ding, K. H. R. Chan, **H. Min**, C. Callison-Burch, and R. Vidal, "Concept lancet: Image editing with compositional representation transplant," in *Conference on Computer Vision and Pattern Recognition(**CVPR**)*, Jun. 2025.

[C16] **H. Min** and R. Vidal, "Gradient flow provably learns robust classifiers for data from orthonormal clusters," in *International Conference on Machine Learning (**ICML**)*, to appear, Jul. 2025.

[C15] Z. Xu, **H. Min**, J. Luo, S. Tarmoun, L. E. MacDonald, E. Mallada, and R. Vidal, "Understanding the learning dynamics of lora: A gradient flow perspective on low-rank adaptation in matrix factorization," in *International Conference on Artificial Intelligence and Statistics (**AISTATS**)*, May 2025.

[C14] Y. Jiang, **H. Min**, and B. Zhang, "Oscillations-aware frequency security assessment via efficient worst-case frequency nadir computation," in *Power Systems Computation Conference (**PSCC**)*, Jun. 2024.

[C13] **H. Min**, E. Mallada, and R. Vidal, "Early neuron alignment in two-layer relu networks with small initialization," in *International Conference on Learning Representations (**ICLR**)*, May 2024.

[C12] **H. Min** and R. Vidal, "Can implicit bias imply adversarial robustness," in *International Conference on Machine Learning (**ICML**)*, Jul. 2024.

[C11] A. Castellano, **H. Min**, J. A. Bazerque, and E. Mallada, "Learning safety critics via a non-contractive binary bellman operator," in *Asilomar Conference on Signals, Systems, and Computers (**ACSSC**)*, Nov. 2023.

[C10] **H. Min** and E. Mallada, "Learning coherent clusters in weakly-connected network systems," in *Learning for Dynamics and Control Conference (**L4DC**)*, Jun. 2023.

[C9] **H. Min** and E. Mallada, "Spectral clustering and model reduction for weakly-connected coherent network systems," in *American Control Conference (**ACC**)*, May 2023.

[C8] **H. Min**, R. Vidal, and E. Mallada, "On the convergence of gradient flow on multi-layer linear models," in *International Conference on Machine Learning (**ICML**)*, Jul. 2023.

[C7] Z. Xu, **H. Min**, S. Tarmoun, E. Mallada, and R. Vidal, "Linear convergence of gradient descent for finite width over-parametrized linear networks with general initialization," in *International Conference on Artificial Intelligence and Statistics (**AISTATS**)*, Apr. 2023.

[C6] A. Castellano, **H. Min**, J. A. Bazerque, and E. Mallada, "Reinforcement learning with almost sure constraints," in *Learning for Dynamics and Control Conference (**L4DC**)*, Mar. 2022.

[C5] **H. Min**, F. Paganini, and E. Mallada, "Accurate reduced-order models for heterogeneous coherent generators," in *American Control Conference (**ACC**)*, Jun. 2021.

[C4] **H. Min**, S. Tarmoun, R. Vidal, and E. Mallada, "On the explicit role of initialization on the convergence and implicit bias of overparametrized linear networks," in *International Conference on Machine Learning (**ICML**)*, Jul. 2021.

[C3] **H. Min** and E. Mallada, "Dynamics concentration of tightly-connected large-scale networks," in *IEEE Conference on Decision and Control (**CDC**)*, Dec. 2019.

[C2] **H. Min**, F. Paganini, and E. Mallada, "Accurate reduced order models for coherent synchronous generators," in *Allerton Conference on Communication, Control, and Computing (**Allerton**)*, Sep. 2019.

[C1] O. Arslan, **H. Min**, and D. E. Koditschek, "Voronoi-based coverage control of pan/tilt/zoom camera networks," in *IEEE International Conference on Robotics and Automation (**ICRA**)*, May 2018.

Thesis

[T2] **H. Min**, "Exploiting structural properties in the analysis of high-dimensional dynamical systems," Ph.D. Thesis, Johns Hopkins University, 2023.

[T1] **H. Min**, "On balancing event and area coverage in mobile sensor networks," Master's Thesis, University of Pennsylvania, 2018.

PRESENTATIONS

Talks

- **Jan. 2025**: Learning Dynamics, Implicit Bias, and Robustness of Shallow Neural Networks.
  School of Data Science, The Chinese University of Hong Kong, Shenzhen.
- **Jan. 2025**: Learning Dynamics, Implicit Bias, and Robustness of Overparemterized Networks.
  Institute of Natural Sciences, Shanghai Jiaotong University
- **Oct. 2024**: Learning Dynamics, Implicit Bias, and Robustness of Shallow Neural Networks.
  "AI + MATH" Colloquia, Virtual, Shanghai Jiaotong University. Host: Zhiqin Xu
- **Nov. 2023**: Early Neuron Alignment in Two-layer ReLU Networks with Small Initialization.
  DeepMath 2023, Johns Hopkins University
- **Jun. 2023**: Spectral Clustering and Model Reduction for Weakly-Connected Coherent Network Systems.
  American Control Conference 2023, San Diego, CA
- **Jan. 2023**: Exploiting Structural Properties in the Analysis of High-dimensional Dynamical Systems.
  University of Michigan. Host: Necmiye Ozay
- **Jan. 2023**: Learning Coherent Clusters in Weakly-Connected Network Systems.
  ROSEI Summit, Johns Hopkins University
- **Jun. 2022**: Convergence and Implicit Bias of Gradient Flow on Overparametrized Linear Networks.
  RSRG Seminar, California Institute of Technology. Hosts: Adam Wierman, Steven Low
- **Jun. 2022**: Convergence and Implicit Bias of Gradient Flow on Overparametrized Linear Networks.
  Semiautonomous seminar, UCBerkeley. Hosts: Chinmay Maheshwari, Shankar Sastry
- **Mar. 2022**: Convergence and Implicit Bias of Gradient Flow on Overparametrized Linear Networks.
  MINDS Retreat, Johns Hopkins University

- **Jan. 2022**: Convergence and Implicit Bias of Gradient Flow on Overparametrized Linear Networks.
  2022 TRIPODS Winter School on Interplay between AI and Dyn. Sys., Virtual
- **May. 2021**: Accurate Reduced Order Models for Coherent Heterogeneous Generators.
  American Control Conference 2021, Virtual.
- **Dec. 2019**: Dynamics Concentration of Tightly-Connected Large-Scale Networks.
  58th Conference on Decision and Control, Nice, France. Dec. 2019

Posters

- **Nov. 2024**: Can Implicit Bias Imply Adversarial Robustness?
  CLEVR-AI MURI Meeting, Northeastern University in Arlington.
- **Sep. 2024**: Can Implicit Bias Imply Adversarial Robustness?
  2024 Mathematical and Scientific Foundations of Deep Learning Annual Meeting, NYC.
- **Jul. 2024**: Can Implicit Bias Imply Adversarial Robustness?
  The 41st International Conference on Machine Learning.
- **May. 2024**: Early Neuron Alignment in Two-layer ReLU Networks with Small Initialization.
  The 12th International Conference on Learning Representations.
- **Aug. 2023**: On the Convergence of Gradient Flow on Multi-layer Linear Models.
  The 40th International Conference on Machine Learning.
- **Jul. 2023**: Learning Coherent Clusters in Weakly-Connected Network Systems.
  The 5th Annual Learning for Dynamics & Control Conference, Philadelphia, PA.
- **Sep. 2021**: On the Explicit Role of Initialization on the Convergence and Implicit Bias of Overparametrized Linear Networks.
  2021 Mathematical and Scientific Foundations of Deep Learning Annual Meeting, NYC.

PROFESSIONAL SERVICES

Technical Reviewer

- *Journals*: Transactions on Pattern Analysis and Machine Intelligence (TPAMI); Journal of Machine Learning Research (JMLR); Transaction on Machine Learning Research (TMLR); Transaction on Automatic Control (TAC); Automatica; Control System Letter (L-CSS)
- *Conferences*: International Conference on Machine Learning (ICML), 2022-2025; Conference on Neural Information Processing Systems (NeurIPS), 2021-2025; International Conference on Learning Representations (ICLR), 2022-2025; International Conference on Artificial Intelligence and Statistics (AISTATS), 2025; Conference on Decision and Control (CDC), 2023,2025; American Control Conference (ACC), 2022; Conference on Information Sciences and Systems (CISS), 2023;

University Service

- Pre-evaluation Admission Committee Member: UPenn ESE PhD Student Search *Dec. 2023*

AWARDS AND HONORS

AI x Science Postdoctoral Fellowship, Data Driven Discovery Initiative at Penn	*Nov. 2024*
MINDS Data Science Spring Fellowship 2021	*Jan. 2021*
MINDS Data Science Fellowship 2019/2020	*Nov. 2019*
ICRA 2018 Best Paper in Multirobot Nominee	*Mar. 2018*
Tongji Scholarship of Excellence	*2013-2015*
Chinese Mathematics Competition (Shanghai Preliminary)	*Nov. 2013*

TEACHING EXPERIENCE

Teaching Assistant

- *Foundations of Reinforcement Learning* (Fall 2020, Fall 2021, Fall 2022), Johns Hopkins University
- *Control Systems*, (Spring 2022), Johns Hopkins University
- *Networked Dynamical Systems*, (Fall 2019), Johns Hopkins University
- *edX Course: Robotics: Locomotion and Engineering* (Spring 2018), Penn Engineering Online Learning

Internship Mentor

- *Army Educational Outreach Program (AEOP) High School Internship Mentor* (June-Aug 2024), University of Pennsylvania

ADVISING AND MENTORING

Mentoring

Leandro Palma *Ph.D. Student, University of Pennsylvania*
Department of Computer and Information Science. Advisor: René Vidal
Research Project: Neural network pruning; Efficient network models.

Prisha Shroff *High School Intern, Hamilton High School*
Army Educational Outreach Program (AEOP) High School Intern at University of Pennsylvania
Research Project: Orthogonal matching pursuit for interpretable image classification

Salma Tarmoun *Ph.D. Student, University of Pennsylvania*
Department of Mathematics. Advisor: René Vidal
Research Projects: Gradient descent dynamics in attention models

Ziqing Xu *Ph.D. Student, University of Pennsylvania*
Wharton Statistics and Data Science. Advisor: René Vidal
Research Projects: Convergence of gradient descent on linear networks; Convergence analysis of LoRA

Agustin Castellano *Ph.D. Student, Johns Hopkins University*
Department of Electrical and Computer Engineering. Advisor: Enrique Mallada
Research Project: Reinforcement learning with almost sure safety

REFERENCES

Enrique Mallada *Ph.D. Advisor*
Associate Professor, Electrical and Computer Engineering
Johns Hopkins University, Baltimore, MD

René Vidal *Postdoc Advisor*
Rachleff University Professor, Electrical and Systems Engineering
University of Pennsylvania, Philadelphia, PA

Fernando Paganini
Professor, Electrical and Telecommunications Engineering
Universidad ORT Uruguay, Montevideo, Uruguay

Eduardo Sontag
University Distinguished Professor, Electrical and Computer Engineering
Northeastern University, Boston, MA

Hamed Hassani
Associate Professor, Electrical and Systems Engineering
University of Pennsylvania, Philadelphia, PA

Necmiye Ozay
Chen-Luan Family Faculty Development Professor, Electrical and Computer Engineering
University of Michigan, Ann Arbor, MI