

# HANCHENG MIN

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*Institute of Natural Sciences & School of Mathematical Sciences*

*Shanghai Jiao Tong University*

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

## EDUCATION

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<b>Johns Hopkins University</b> , Baltimore, MD Ph.D., Electrical and Computer Engineering	<i>Sep. 2018 – Jul. 2023</i>
<b>University of Pennsylvania</b> , Philadelphia, PA Master of Science in Engineering, Electrical and Systems Engineering	<i>Sep. 2016 – May. 2018</i>
<b>Tongji University</b> , Shanghai, China Bachelor of Engineering, Automation	<i>Sep. 2012 – Jul. 2016</i>

## ACADEMIC APPOINTMENTS

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<b>Tenure-track Associate Professor</b> Institute of Natural Sciences and School of Mathematical Sciences Shanghai Jiao Tong University	<i>Aug. 2025 – Present</i>
<b>Postdoctoral Researcher</b> Vidal-lab, <i>Advisor:</i> René Vidal University of Pennsylvania	<i>Aug. 2023 – Jul. 2025</i>
<b>Graduate Research Assistant</b> NetD-lab, <i>Primary Advisor:</i> Enrique Mallada; <i>Co-advisor:</i> René Vidal Johns Hopkins University	<i>Sep. 2018 – Jul. 2023</i>
<b>Graduate Research Assistant</b> Kod*lab, <i>Mentor:</i> Ömür Arslan University of Pennsylvania	<i>Jun. 2017 – May. 2018</i>

## PUBLICATIONS

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### Preprints

- [P2] **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*.
- [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.

### Journals

- [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.

## Conferences

- [C19] 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.
- [C18] **H. Min** and R. Vidal, “Gradient flow provably learns robust classifiers for orthonormal GMMs,” in *International Conference on Machine Learning (ICML)*, to appear, Jul. 2025.
- [C17] **H. Min** and R. Vidal, “Understanding incremental learning with closed-form solution to gradient flow on overparameterized matrix factorization,” in *IEEE Conference on Decision and Control (CDC)*, to appear, Dec. 2025.
- [C16] F. Tian, T. Ding, J. Luo, **H. Min**, and R. Vidal, “Voyaging into unbounded dynamic scenes from a single view,” in *International Conference on Computer Vision (ICCV)*, to appear, Oct. 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

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### Talks

- **Jul. 2025:** Simplicity Bias in Shallow Neural Networks  
*School of Data Science, The Chinese University of Hong Kong, Shenzhen. Host: Yan Jiang, Tongxin Li*
- **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 Overparametrized Networks  
*Institute of Natural Sciences, Shanghai Jiao Tong University*
- **Oct. 2024:** Learning Dynamics, Implicit Bias, and Robustness of Shallow Neural Networks  
*"AI + MATH" Colloquia, Virtual, Shanghai Jiao Tong 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, UC Berkeley. 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

- **Jul. 2024:** Gradient Flow Provably Learns Robust Classifiers for Orthonormal GMMs  
*The 42nd International Conference on Machine Learning.*
- **Jun. 2025:** Concept Lancet: Image Editing with Compositional Representation Transplant  
*The IEEE/CVF Conference on Computer Vision and Pattern Recognition 2025*
- **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**

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### 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; International Conference on Computer Vision (ICCV), 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

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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

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### 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

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### Mentoring

**Fengrui Tian** *Ph.D. Student, University of Pennsylvania*

Department of Computer and Information Science. Advisor: René Vidal

*Research Project:* 3D dynamical scene generation

**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

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**Enrique Mallada**

Associate Professor, Electrical and Computer Engineering  
Johns Hopkins University, Baltimore, MD

*Ph.D. Advisor*

**René Vidal**

Rachleff University Professor, Electrical and Systems Engineering  
University of Pennsylvania, Philadelphia, PA

*Postdoc Advisor*

**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