Stephen Tu

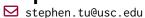✉ stephen.tu@usc.edu   🌐 https://stephentu.github.io

Research Summary

I study problems at the intersection of machine learning, optimization, and control theory. My recent work focuses on developing a principled understanding of using machine learning models for data-driven control, with specific emphasis on applications in robotics.

Employment History

2024 – Now	**Assistant Professor** Ming Hsieh Department of Electrical and Computer Engineering Thomas Lord Department of Computer Science (by courtesy) University of Southern California
2019 – 2023	**Research Scientist** Google DeepMind Robotics New York, NY
2014 – 2019	**Research Assistant** Department of Electrical Engineering and Computer Sciences University of California, Berkeley
2011 – 2014	**Research Assistant** Department of Electrical Engineering and Computer Science Massachusetts Institute of Technology

Education

2014 – 2019	**Ph.D., EECS**, University of California, Berkeley Thesis title: *Sample Complexity Bounds for the Linear Quadratic Regulator* Advisor: Prof. Benjamin Recht
2011 – 2014	**S.M., EECS**, Massachusetts Institute of Technology Thesis title: *Fast Transactions for Multicore In-Memory Databases* Advisor: Prof. Samuel Madden
2006 – 2011	**B.A., Computer Science**, University of California, Berkeley **B.S., Mechanical Engineering**, University of California, Berkeley

Research Funding

9/25–9/26	**2025 Okawa Foundation Research Grant** Role: Solo-PI Amount: 10k
8/25–8/28	**NSF CPS Medium: Latent Representation Learning for Verifiable Sensor Rich Systems** Role: Lead-PI (Co-PIs: Lars Lindemann, Yue Wang) Amount: 400k of 1.2M
8/25–8/26	**Generative AI for Financial Decision-Making in Noisy, Dynamic, and Agentic Settings** Sponsor: USC-Capital One Center for Responsible AI Decision Making in Finance (CREDIF) Role: Co-PI (Lead-PI: Mahdi Soltanolkotabi) Amount: 20k

Research Publications

Preprints

[1]   A. Liang, P. Czempin, M. Hong, Y. Zhou, E. Bıyık, and **S. Tu**, *CLAM: Continuous latent action models for robot learning from unlabeled demonstrations*, Preprint, 2025. arXiv: `arXiv:2505.04999 [cs.RO]`.

[2]   S. Park and **S. Tu**, *Integration matters for learning PDEs with backwards SDEs*, Preprint, 2025. arXiv: `arXiv:2505.01078 [cs.LG]`.

Journal Articles

[1]   A. A. Ahmadi, A. Chaudhry, V. Sindhwani, and **S. Tu**, "Safely learning dynamical systems," *Foundations of Computational Mathematics*, 2025, ISSN: 1615-3383.

[2]   L. Lindemann, A. Robey, L. Jiang, S. Das, **S. Tu**, and N. Matni, "Learning robust output control barrier functions from safe expert demonstrations," *IEEE Open Journal of Control Systems*, vol. 3, pp. 158–172, 2024.

[3]   S. Singh, **S. Tu**, and V. Sindhwani, "Revisiting energy based models as policies: Ranking noise contrastive estimation and interpolating energy models," *Transactions on Machine Learning Research*, 2024, ISSN: 2835-8856.

[4]   **S. Tu**, R. Frostig, and M. Soltanolkotabi, "Learning from many trajectories," *Journal of Machine Learning Research*, vol. 25, no. 216, pp. 1–109, 2024.

[5]   N. M. Boffi, **S. Tu**, and J.-J. E. Slotine, "Nonparametric adaptive control and prediction: Theory and randomized algorithms," *Journal of Machine Learning Research*, vol. 23, no. 281, pp. 1–46, 2022.

[6]   S. Dean, H. Mania, N. Matni, B. Recht, and **S. Tu**, "On the sample complexity of the linear quadratic regulator," *Foundations of Computational Mathematics*, vol. 20, no. 4, pp. 633–679, 2020.

Conference Proceedings

[1]   N. M. Boffi, A. Jacot, **S. Tu**, and I. Ziemann, "Single hidden layer diffusion models provably learn simple low-dimensional structure," in *The Thirteenth International Conference on Learning Representations*, 2025.

[2]   E. Dietrich, R. Devonport, **S. Tu**, and M. Arcak, "Data-driven reachability with scenario optimization and the holdout method," in *2025 IEEE 64th Conference on Decision and Control (to appear)*, 2025.

[3]   P. Lutkus, D. Anantharaman, **S. Tu**, and L. Lindemann, "Incremental composition of learned control barrier functions in unknown environments," in *2025 IEEE 64th Conference on Decision and Control (to appear)*, 2025.

[4]   P. Lutkus, K. Wang, L. Lindemann, and **S. Tu**, "Latent representations for control design with provable stability and safety guarantees," in *2025 IEEE 64th Conference on Decision and Control (to appear)*, 2025.

[5]   I. Ziemann, **S. Tu**, G. J. Pappas, and N. Matni, "Sharp rates in dependent learning theory: Avoiding sample size deflation for the square loss," in *Proceedings of the 41st International Conference on Machine Learning*, vol. 235, PMLR, 2024.

[6]   S. Abeyruwan, A. Bewley, N. M. Boffi, K. M. Choromanski, D. B. D'Ambrosio, D. Jain, P. R. Sanketi, A. Shankar, V. Sindhwani, S. Singh, J.-J. Slotine, and **S. Tu**, "Agile catching with whole-body mpc and blackbox policy learning," in *Proceedings of The 5th Annual Learning for Dynamics and Control Conference*, vol. 211, PMLR, 2023, pp. 851–863.

[7]   D. Brandfonbrener, **S. Tu**, A. Singh, S. Welker, C. Boodoo, N. Matni, and J. Varley, "Visual backtracking teleoperation: A data collection protocol for offline image-based reinforcement learning," in *2023 IEEE International Conference on Robotics and Automation (ICRA)*, 2023.

[8]   C. Le Lan, **S. Tu**, M. Rowland, A. Harutyunyan, R. Agarwal, M. G. Bellemare, and W. Dabney, "Bootstrapped representations in reinforcement learning," in *Proceedings of the 40th International Conference on Machine Learning*, vol. 202, PMLR, 2023.

[9]   D. Pfrommer, M. Simchowitz, T. Westenbroek, N. Matni, and **S. Tu**, "The power of learned locally linear models for nonlinear policy optimization," in *Proceedings of the 40th International Conference on Machine Learning*, vol. 202, PMLR, 2023.

[10]   A. Z. Ren, A. Dixit, A. Bodrova, S. Singh, **S. Tu**, N. Brown, P. Xu, L. Takayama, F. Xia, J. Varley, Z. Xu, D. Sadigh, A. Zeng, and A. Majumdar, "Robots that ask for help: Uncertainty alignment for large language model planners," in *7th Annual Conference on Robot Learning*, **(Best Student Paper)**, 2023.

[11]   T. T. Zhang, K. Kang, B. D. Lee, C. Tomlin, S. Levine, **S. Tu**, and N. Matni, "Multi-task imitation learning for linear dynamical systems," in *Proceedings of The 5th Annual Learning for Dynamics and Control Conference*, vol. 211, PMLR, 2023, pp. 586–599.

[12]   I. Ziemann, **S. Tu**, G. J. Pappas, and N. Matni, "The noise level in linear regression with dependent data," in *Advances in Neural Information Processing Systems*, vol. 36, 2023.

[13]   N. Boffi, **S. Tu**, and J.-J. Slotine, "The role of optimization geometry in single neuron learning," in *Proceedings of The 25th International Conference on Artificial Intelligence and Statistics*, vol. 151, PMLR, 2022.

[14]   C. Le Lan, **S. Tu**, A. Oberman, R. Agarwal, and M. G. Bellemare, "On the generalization of representations in reinforcement learning," in *Proceedings of The 25th International Conference on Artificial Intelligence and Statistics*, vol. 151, PMLR, 2022.

[15]   D. Pfrommer, T. T. Zhang, **S. Tu**, and N. Matni, "Tasil: Taylor series imitation learning," in *Advances in Neural Information Processing Systems*, vol. 35, 2022.

[16]   **S. Tu**, A. Robey, T. Zhang, and N. Matni, "On the sample complexity of stability constrained imitation learning," in *Proceedings of The 4th Annual Learning for Dynamics and Control Conference*, PMLR, 2022.

[17]   X. Xiao, T. Zhang, K. Choromanski, E. Lee, A. Francis, J. Varley, **S. Tu**, S. Singh, P. Xu, F. Xia, S. M. Persson, D. Kalashnikov, L. Takayama, R. Frostig, J. Tan, C. Parada, and V. Sindhwani, "Learning model predictive controllers with real-time attention for real-world navigation," in *Proceedings of the 2022 Conference on Robot Learning*, PMLR, 2022.

[18]   T. Zhang, **S. Tu**, N. Boffi, J.-J. Slotine, and N. Matni, "Adversarially robust stability certificates can be sample-efficient," in *Proceedings of The 4th Annual Learning for Dynamics and Control Conference*, PMLR, 2022.

[19]   I. Ziemann and **S. Tu**, "Learning with little mixing," in *Advances in Neural Information Processing Systems*, vol. 35, 2022.

[20]   A. A. Ahmadi, A. Chaudhry, V. Sindhwani, and **S. Tu**, "Safely learning dynamical systems from short trajectories," in *Proceedings of the 3rd Conference on Learning for Dynamics and Control*, vol. 144, PMLR, 2021.

[21]   N. M. Boffi, **S. Tu**, and J.-J. Slotine, "Nonparametric adaptive control and prediction: Theory and randomized algorithms," in *2021 60th IEEE Conference on Decision and Control (CDC)*, 2021, pp. 2935–2942.

[22]   N. M. Boffi, **S. Tu**, and J.-J. E. Slotine, "Regret bounds for adaptive nonlinear control," in *Proceedings of the 3rd Conference on Learning for Dynamics and Control*, PMLR, 2021.

[23]   L. Lindemann, H. Hu, A. Robey, H. Zhang, D. Dimarogonas, **S. Tu**, and N. Matni, "Learning hybrid control barrier functions from data," in *Proceedings of the 2020 Conference on Robot Learning*, vol. 155, PMLR, 2021.

[24]   A. Robey, L. Lindemann, **S. Tu**, and N. Matni, "Learning robust hybrid control barrier functions for uncertain systems," in *7th IFAC Conference on Analysis and Design of Hybrid Systems ADHS 2021*, vol. 54, 2021, pp. 1–6.

[25] N. Boffi, **S. Tu**, N. Matni, J.-J. Slotine, and V. Sindhwani, "Learning stability certificates from data," in *Proceedings of the 2020 Conference on Robot Learning*, PMLR, 2020.

[26] A. Robey, H. Hu, L. Lindemann, H. Zhang, D. V. Dimarogonas, **S. Tu**, and N. Matni, "Learning control barrier functions from expert demonstrations," in *2020 59th IEEE Conference on Decision and Control (CDC)*, 2020, pp. 3717–3724.

[27] X. Song, Y. Jiang, **S. Tu**, Y. Du, and B. Neyshabur, "Observational overfitting in reinforcement learning," in *International Conference on Learning Representations*, 2020.

[28] S. Dean, **S. Tu**, N. Matni, and B. Recht, "Safely learning to control the constrained linear quadratic regulator," in *2019 American Control Conference (ACC)*, 2019, pp. 5582–5588.

[29] K. Krauth, **S. Tu**, and B. Recht, "Finite-time analysis of approximate policy iteration for the linear quadratic regulator," in *Advances in Neural Information Processing Systems*, vol. 32, 2019.

[30] H. Mania, **S. Tu**, and B. Recht, "Certainty equivalence is efficient for linear quadratic control," in *Advances in Neural Information Processing Systems*, 2019.

[31] N. Matni, A. Proutiere, A. Rantzer, and **S. Tu**, "From self-tuning regulators to reinforcement learning and back again," in *2019 IEEE 58th Conference on Decision and Control (CDC)*, 2019, pp. 3724–3740.

[32] N. Matni and **S. Tu**, "A tutorial on concentration bounds for system identification," in *2019 IEEE 58th Conference on Decision and Control (CDC)*, 2019, pp. 3741–3749.

[33] **S. Tu**, R. Boczar, and B. Recht, "Minimax lower bounds for H_∞-norm estimation," in *2019 American Control Conference (ACC)*, 2019, pp. 3538–3543.

[34] **S. Tu** and B. Recht, "The gap between model-based and model-free methods on the linear quadratic regulator: An asymptotic viewpoint," in *Proceedings of the Thirty-Second Conference on Learning Theory*, PMLR, 2019.

[35] S. Dean, H. Mania, N. Matni, B. Recht, and **S. Tu**, "Regret bounds for robust adaptive control of the linear quadratic regulator," in *Advances in Neural Information Processing Systems*, 2018.

[36] M. Simchowitz, H. Mania, **S. Tu**, M. I. Jordan, and B. Recht, "Learning without mixing: Towards a sharp analysis of linear system identification," in *Proceedings of the 31st Conference On Learning Theory*, PMLR, 2018.

[37] **S. Tu**, R. Boczar, and B. Recht, "On the approximation of toeplitz operators for nonparametric $\mathcal{H}_\infty$-norm estimation," in *2018 Annual American Control Conference (ACC)*, 2018, pp. 1867–1872.

[38] **S. Tu** and B. Recht, "Least-squares temporal difference learning for the linear quadratic regulator," in *Proceedings of the 35th International Conference on Machine Learning*, vol. 80, PMLR, 2018.

[39] **S. Tu**, S. Venkataraman, A. C. Wilson, A. Gittens, M. I. Jordan, and B. Recht, "Breaking locality accelerates block Gauss-Seidel," in *Proceedings of the 34th International Conference on Machine Learning*, vol. 70, PMLR, 2017.

[40] X. Pan, M. Lam, **S. Tu**, D. Papailiopoulos, C. Zhang, M. I. Jordan, K. Ramchandran, and C. Ré, "Cyclades: Conflict-free asynchronous machine learning," in *Advances in Neural Information Processing Systems*, vol. 29, 2016.

[41] **S. Tu**, R. Boczar, M. Simchowitz, M. Soltanolkotabi, and B. Recht, "Low-rank solutions of linear matrix equations via procrustes flow," in *Proceedings of The 33rd International Conference on Machine Learning*, vol. 48, PMLR, 2016.

[42] R. Bost, R. A. Popa, **S. Tu**, and S. Goldwasser, "Machine learning classification over encrypted data," in *Network and Distributed System Security (NDSS) Symposium*, 2015.

[43] W. Zheng, **S. Tu**, E. Kohler, and B. Liskov, "Fast databases with fast durability and recovery through multicore parallelism," in *Proceedings of the 11th USENIX Conference on Operating Systems Design and Implementation*, 2014, pp. 465–477.

[44] J. DeBrabant, A. Pavlo, **S. Tu**, M. Stonebraker, and S. Zdonik, "Anti-caching: A new approach to database management system architecture," in *Proc. VLDB Endow.*, vol. 6, 2013, pp. 1942–1953.

[45] **S. Tu**, M. F. Kaashoek, S. Madden, and N. Zeldovich, "Processing analytical queries over encrypted data," 5, vol. 6, 2013, pp. 289–300.

[46] **S. Tu**, W. Zheng, E. Kohler, B. Liskov, and S. Madden, "Speedy transactions in multicore in-memory databases," in *Proceedings of the Twenty-Fourth ACM Symposium on Operating Systems Principles*, Association for Computing Machinery, 2013, pp. 18–32.

[47] H. Zhao, I. Proctor, M. Yang, X. Qi, M. Williams, Q. Gao, G. Ottoni, A. Paroski, S. MacVicar, J. Evans, and **S. Tu**, "The hiphop compiler for php," in *SIGPLAN Not.*, vol. 47, Association for Computing Machinery, 2012, pp. 575–586.

[48] M. Armbrust, N. Lanham, **S. Tu**, A. Fox, M. J. Franklin, and D. A. Patterson, "The case for piql: A performance insightful query language," in *Proceedings of the 1st ACM Symposium on Cloud Computing*, Association for Computing Machinery, 2010, pp. 131–136.

[49] M. Armbrust, **S. Tu**, A. Fox, M. J. Franklin, D. A. Patterson, N. Lanham, B. Trushkowsky, and J. Trutna, "Piql: A performance insightful query language," in *Proceedings of the 2010 ACM SIGMOD International Conference on Management of Data*, Association for Computing Machinery, 2010, pp. 1207–1210.

Talks

6/25	**Challenges in Learning Behavior Certificates from Data**
	Statistical Uncertainty Quantification in the Era of AI-Enabled Robots Workshop, RSS 2025
3/25	**On the Effectiveness of Generative Modeling for Planning and Control**
	Computer Science Colloquium, University of Southern California
	CRI Seminar, UC San Diego
2/25	**Shallow diffusion networks provably learn hidden low-dimensional structure**
	Information Theory and Applications, 2025
2/24	**Towards instance optimal rates in learning from dependent data**
	Information Theory and Applications, 2024
11/23	**Revisiting Energy Based Models as Policies**
	Stanford Vision and Learning Lab, Stanford University
6/23	**jax4dc Tutorial**
	Learning for Dynamics & Control Conference, 2023
Sp. 23	**The foundations of machine learning for feedback control**
	Computer Science Colloquium, UC Riverside
	EECS Colloquium, UC Irvine
	Computer Science Colloquium, University of Chicago
	ECE Colloquium, University of Michigan
	ECE Colloquium, University of Southern California
2022–23	**Learning from many trajectories**
	Information Theory and Applications, 2023
	Learning Theory for Control Workshop, IEEE Conference on Decision and Control, 2022
	Machine Learning in Feedback Systems (CS 6784) Guest Lecture, Cornell University
	Intelligent Robot Motion Lab, Princeton University
2022-23	**Introduction to High Dimensional Probability (Part I and II)**
	Google Brainiversity Lecture Series

Talks (continued)

11/22	**Independent learning from sequential data**	
	Foundations of AI Seminar, University of Southern California	
6/21	**Learning and Control with Safety and Stability Guarantees for Nonlinear Systems**	
	Foundations and mathematical guarantees of data-driven control summer school, ETHZ-EPFL	
Fa. 20	**Learning Stability Certificates from Data**	
	CAN Lab, New York University	
	Research Seminar, TU Darmstadt	
12/19	**Concentration Inequalities for System Identification**	
	Tutorial Session, IEEE Conference on Decision and Control, 2019	
	Seminar, Lund University	
10/19	**Finite-time Analysis of Approximate Policy Iteration for the Linear Quadratic Regulator**	
	INFORMS Conference, 2019	
7/19	**Minimax Lower Bounds for H_∞-Norm Estimation**	
	American Control Conference, 2019	
Su. 19	**The Gap Between Model-Based and Model-Free Methods on the Linear Quadratic Regulator: An Asymptotic Viewpoint**	
	International Conference on Continuous Optimization, 2019	
	Conference on Learning Theory, 2019	
Sp. 19	**Safe and Reliable Reinforcement Learning for Continuous Control**	
	Amazon Research, Palo Alto	
	Facebook AI Research, Menlo Park	
	Robot Locomotion Group, Massachusetts Institute of Technology	
	Machine Learning Seminar, University of Washington	
	Google DeepMind, London	
	Google Brain Robotics, Mountain View	
	Computer Science Colloquium, Princeton University	
	Microsoft Research, New York City	
6/18	**On the Approximation of Toeplitz Operators for Nonparametric H_∞-norm Estimation**	
	American Control Conference, 2018	
5/18	**Finite Sample Guarantees for Control of an Unknown Linear Dynamical System**	
	Stanford Information Systems Laboratory, Stanford University	
Fa. 17	**A Lyapunov Analysis for Accelerated Block Gauss-Seidel**	
	Simons Institute, UC Berkeley	
8/17	**Breaking Locality Accelerates Block Gauss-Seidel**	
	International Conference on Machine Learning, 2017	
5/17	**Convergence and Geometry of Non-convex Matrix Sensing**	
	SIAM Conference on Optimization, 2017	
6/16	**Low-rank Solutions of Linear Matrix Equations via Procrustes Flow**	
	International Conference on Machine Learning, 2016	
2013	**Speedy Transactions in Multicore In-Memory Databases**	
	Symposium on Operating Systems Principles, 2013	
	Microsoft Research, Redmond	
8/13	**Processing Analytical Queries over Encrypted Data**	
	International Conference on Very Large Data Bases, 2013	

Awards and Honorable Mentions

2023 **Best Student Paper Award**, Conference on Robot Learning 2023
(co-author on paper with A. Ren, lead student author)

2021 **Outstanding Reviewer**, NeurIPS 2021

2018 **Google PhD Fellowship in Machine Learning**

2011 **CRA Undergraduate Research Award Honorable Mention**

Teaching

EE660 **Mathematical Foundations of Machine Learning**, University of Southern California
Semesters: Sp. 2024, Fa. 2024, Fa. 2025

CS189 **Introduction to Machine Learning (GSI)**, University of California, Berkeley
Semesters: Fa. 2016, Fa. 2018

Service

Ongoing **Reviewer**, NeurIPS, ICML, ACC, CDC, AISTATS, COLT, CoRL, L4DC, and JMLR

Program Co-Chair, Learning for Dynamics and Control Conference, 2026

Guest Associate Editor, IEEE Open Journal of Control Systems (OJ-CSYS)

2025 **Area Chair**, NeurIPS, 2025

Program Committee, Learning for Dynamics and Control Conference, 2025

2024 **Co-Organizer**, Southern California Control Workshop, Fall 2024

Session Organizer, Information Theory and Applications, 2024
Session: *Statistical learning for analysis and design of control systems*

2023 **Area Chair**, NeurIPS, 2023

2022 **Mentor**, Google CS Research Mentorship Program

2018 **Mentor**, BAIR Undergraduate Mentoring Program

References

Available on Request