Chih-Fan (Rich) Pai

Ph.D. Candidate, UC San Diego

Electrical and Computer Engineering
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Research Interests

Online prediction and control of dynamical systems, online/interactive optimization, reinforcement learning, and general decision-making problems under uncertainty.

Education

University of California, San Diego Sept. 2026 (Expected)
Ph.D., Electrical and Computer Engineering
J. Yang Scholarship

National Taiwan University 2020
M.S., Communication Engineering
Best Master's Thesis Award; Youth Thesis First Prize

National Yang Ming Chiao Tung University 2018
B.S., Electrical and Computer Engineering
Academic Excellence Award

Publications

- **C.-F. Pai** and Y. Zheng. *Online Nonstochastic Prediction: Logarithmic Regret via Predictive Online Least Squares*. *Preprint*.
- **C.-F. Pai**, Y. Tang, and Y. Zheng. *Policy Optimization of Mixed $\mathcal{H}_2/\mathcal{H}_\infty$ Control: Benign Nonconvexity and Global Optimality*. Provisionally accepted, under review at *Automatica*.
- Y. Zheng, **C.-F. Pai**, and Y. Tang. *Benign Nonconvex Landscapes in Optimal and Robust Control, Part I: Global Optimality*. *IEEE Transactions on Automatic Control*, 2026.
- Y. Zheng, **C.-F. Pai**, and Y. Tang. *Benign Nonconvex Landscapes in Optimal and Robust Control, Part II: Extended Convex Lifting*. *IEEE Transactions on Automatic Control*, 2026.
- **C.-F. Pai**, X. Shang, J. Qian, and Y. Zheng. *Online Tracking with Predictions for Nonlinear Systems with Koopman Linear Embedding*. *Learning for Dynamics and Control (L4DC)*, 2026.
- Y. Watanabe, **C.-F. Pai**, and Y. Zheng. *Semidefinite Programming Duality in Infinite-Horizon LQ Differential Games*. *IEEE Conference on Decision and Control (CDC)*, 2025.
- Y. Zheng, **C.-F. Pai**, and Y. Tang. *Extended Convex Lifting for Policy Optimization of Optimal and Robust Control*. *Learning for Dynamics and Control (L4DC)*, 2025.

Research Experience

University of California, San Diego 2023–Present
Ph.D. Research Assistant, Advisor: Professor Yang Zheng

Online Prediction and Control of Dynamical Systems

2025–Present

- Designed and analyzed sequential prediction and online non-stochastic control algorithms in uncertain and nonstationary dynamic environments using tools from online learning and optimization.
- Developed sequential output prediction algorithms for linear dynamical systems with logarithmic regret guarantees via online least squares with tailored predictive hints.

- Developed data-driven predictive tracking/control algorithms for Koopman linearizable nonlinear systems and derived its dynamic regret guarantees.

Convex and Nonconvex Optimization in Control
2023–2025

- Analyzed the optimization landscapes of classical optimal and robust control problems from a modern policy optimization perspective, including LQR and H-infinity robust control.
- Established a new geometric and structural characterization of mixed $\mathcal{H}_2/\mathcal{H}_\infty$ control, uncovering connections between policy optimization, classical Riccati theory, and convex reformulations.
- Developed a unified Extended Convex Lifting framework that reveals hidden convexity in nonconvex control policy optimization, covering both static state-feedback and dynamic output-feedback policies.

Selected Talks

- **Decision-making in Uncertain Dynamic Environments**
  Invited seminar, CS Department, National Yang Ming Chiao Tung University, Dec. 2025.
- **Online Non-stochastic Control: A Regret-Minimizing Approach**
  Invited presentation, DSC 291: Online Learning
  Host: Professor Yoav Freund, UC San Diego, March 2025.
- **Policy Optimization for Mixed Control: Benign Nonconvexity and Global Optimality**
  Southern California Control Workshop, University of Southern California, Nov. 2024.

Industry Experience

Qualcomm, Audio R&D Intern Summer 2025

- Designed adaptive active noise cancellation algorithms under real-time and hardware constraints.
- Balanced convergence, robustness, and stability using optimization and robust control theory.

Teaching Experience

Teaching Assistant, UC San Diego

ECE 285: Agentic AI and LLMs for Smart Grids
ECE 228: Machine Learning for Physical Applications
ECE 285: Semidefinite and Sum-of-Squares Optimization
ECE 171A: Linear Control System Theory
ECE 101: Linear Systems Fundamentals

- Led discussion sessions and developed instructional materials.
- Received consistently strong student evaluations.

Teaching Assistant, National Taiwan University

Linear Algebra (EE), Calculus (MATH), Digital and Multi-rate Signal Processing (CommE)

Programming and Computational Tools

Python, MATLAB, C/C++; PyTorch, TensorFlow; NumPy, Pandas, Scikit-learn.