

# Chih-Fan (Rich) Pai

Ph.D. Candidate, UC San Diego

Electrical and Computer Engineering

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## Research Interests

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Sequential decision-making under uncertainty, with emphasis on online prediction and control of dynamical systems, online/interactive optimization, and reinforcement learning.

## Education

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**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

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- **C.-F. Pai**, Y. Tang, and Y. Zheng. *Policy Optimization of Mixed  $\mathcal{H}_2/\mathcal{H}_\infty$  Control: Benign Nonconvexity and Global Optimality*. 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*, to appear, 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*, to appear, 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

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**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 time-series prediction and online non-stochastic control algorithms in uncertain and nonstationary dynamic environments using tools from online convex 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

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- **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

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### 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

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### 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

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