Chih-Fan Rich Pai

+1-(858)-531-9377 | **cfrpai@gmail.com** | www.linkedin.com/in/cfrpai

Summary

PhD in Optimization, Learning, and Control: Over 3 years of deep expertise in related research and problem-solving
Technical Proficiency: Design and analysis of algorithms for ***optimization/prediction/control for dynamical systems***

Education

University of California, San Diego (UCSD) GPA: 4.0/4.0 — La Jolla, CA
Ph.D. in Electrical and Computer Engineering (Machine Learning and Data Science Track) — *2021 - Sept. 2026 (expected)*

- **Research interest:** Optimization, control, online learning, and sequential decision-making
- **Course:** Machine Learning, Statistical Learning, Planning & Learning in Robotics, Probabilistic Reasoning & Learning, Semidefinite & Sum-of-Squares Optimization, Continuous Optimization, Stochastic Approximation, Information Theory

National Taiwan University (NTU) GPA: 3.99/4.3 — Taipei, Taiwan
M.S. in Communication Engineering (EECS Collage, Signal Processing for Communication Group) — *Feb. 2018 - June 2020*

- **Course:** Machine Learning, Deep Learning for Computer Vision, Matrix Computations, Convex Optimization, Design and Analysis of Algorithms, Adaptive/Multirate Signal Processing, Digital Communication

National Chiao Tung University (NCTU) GPA: 4.14/4.3 (Rank: top 3%) — Hsinchu, Taiwan
B.S. in Electrical and Computer Engineering (Graduated early for academic excellence) — *Sept. 2014 - Jan. 2018*

Internship Experience

Audio R&D Intern, Qualcomm — San Diego, CA
Designed and analyzed adaptive active noise cancellation (ANC) algorithms for wearables and AR audio systems — *Summer 2025*

- Combined ideas from optimization, signal processing, and robust control theory to develop practical solutions

Research Experience

Online learning and nonstochastic prediction/control — Sept. 2024 -
Research Assistant, supervised by Prof. Yang Zheng

- Designed and analyzed algorithms for ***online time-series prediction*** and ***non-stochastic control*** using tools from online convex optimization, ***provably adapting*** across three layers: ***adversarial***, ***nonstationary***, and ***benign*** environments
- Developed ***online predictive tracking*** algorithms with ***dynamic regret*** guarantees for Koopman nonlinear systems

Nonconvex nonsmooth policy optimization for optimal and robust control — Apr. 2023 -
Research Assistant, supervised by Prof. Yang Zheng

- Studied ***optimization landscapes*** of classical optimal and robust control from a modern policy optimization perspective
- Developed the ***Extended Convex Lifting*** framework to reveal ***hidden convexity*** for various nonconvex control problems
- Bridged policy optimization and classical Riccati and LMI-based approaches in robust ***mixed $\mathcal{H}_2/\mathcal{H}_\infty$ control***
- Analyzed ***linear-quadratic differential game*** through a ***primal-dual lens*** using semidefinite program formulations

Reinforcement learning and general sequential decision-making — June 2022 - March 2023
Research Assistant, supervised by Prof. Tara Javidi and Prof. Yian Ma

- Designed algorithms for **reward-free exploration** in RL, focusing on active model estimation for Markov decision processes

Signal processing for communication — June 2018 - Oct. 2020
Research Assistant, supervised by Prof. See-May Phoong

Publications

- **C. Pai**, X. Shang, J. Qian and Y. Zheng. *Online Tracking with Predictions for Koopman-linearizable Nonlinear Systems*[1]
- **C. Pai**, Y. Tang, and Y. Zheng. *Policy Optimization of Mixed $\mathcal{H}_2/\mathcal{H}_\infty$ Control: Benign Nonconvexity and Global Optimality*[1]
- Y. Watanabe, **C. Pai**, and Y. Zheng. *Semidefinite Programming Duality in Infinite-Horizon LQ Differential Games.* CDC 2025
- Y. Zheng, **C. Pai** and Y. Tang. *Extended Convex Lifting for Policy Optimization of Optimal and Robust Control.* L4DC 2025
- Y. Zheng, **C. Pai**, and Yujie Tang. *Benign Nonconvex Landscapes in Optimal and Robust Control, Part I: Global Optimality and Part II: Extended Convex Lifting.* arXiv Preprints, 2023/2024 (under IEEE Transactions on Automatic Control review).
- **C. Pai** and S. Phoong, *Low Complexity Estimation of Time-Varying Channels for OFDM Systems with Uniformly Spaced Pilots.* 32nd European Signal Processing Conference, IEEE, 2024.
- **C. Pai**, T. Hung, and S. Phoong, *Depth-L Nyquist (M) Filters and Biorthogonal Partners.* IEEE Access, Apr. 2020.

[1] Manuscript has been submitted to Automatica

Honors

- **J. Yang Scholarship** from UCSD — Sep. 2021
- **Best Master Thesis Award** from National Taiwan University — Jan. 2021
- **Youth Thesis 1st Award** from Chinese Institute of Electrical Engineering — Jan. 2021
- **NCTU Academic Excellence Award**: 3 times (top 3%) — Sept. 2014 - Jan. 2018

Teaching Experience

TA for the following UCSD ECE courses:

Machine Learning for Physical Applications, Semidefinite SOS Optimization, Linear Systems Fundamentals, Linear Control Theory

- Designed and led weekly discussion sessions using self-prepared instructional materials
- Received highly positive feedback in student evaluations, highlighting clarity and engagement

National Taiwan University — June 2018 - June 2020

Linear Algebra, Calculus, Digital Signal Processing, and Multirate Signal Processing

Selected Project

Algorithmic Game Theory and Multi-objective Optimization Reading Group — Feb. 2022 - Jan. 2023

- Explored mechanism design, equilibrium computation, convergence behavior of learning dynamics, multi-objective optimization, multi-agent and multi-objective reinforcement learning

Theory and Practice of Machine Learning — June 2019 - Apr. 2020

- Explored **why gradient descent almost always avoid saddle points** in minimizing non-convex functions; also explored **surrogate risk minimization** algorithms for SVM, AdaBoost, logistic regression.
- Implemented **regression** for PM2.5 prediction, **probabilistic generative model**, **CNN** for human sentiment classification, and **RNN** for malicious comments identification
- **Ranked 2** in Kaggle among 120 NTU students by applying BERT to **dialogue modeling transfer learning** task

Visualization and Implementation of Deep Learning for Computer Vision — Sept. 2019 - Apr. 2020

- Visualized **what deep CNN learn** with saliency map, deconvolutional network, and deep generator network
- Implemented image reconstruction, clustering and classification using **dimensionality reduction**, e.g., autoencoder, PCA, K-Means, t-SNE; implemented **semantic segmentation** with ResNet50, **GAN** for producing human faces, **DANN** for **transfer learning**, and **LSTM**, **Seq2seq** for video action recognition and segmentation

Programming languages

C, C++, Python, MATLAB, PyTorch, Tensorflow, Scikit-learn, NumPy, Pandas