

Chih-Fan Rich Pai

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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

RESEARCH EXPERIENCE

Online learning, prediction, and nonstochastic 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.

¹Manuscript 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