

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 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.

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