

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 <i>Ph.D. in Electrical and Computer Engineering (Machine Learning and Data Science Track)</i>	La Jolla, CA 2021 - Sept. 2026 (expected)
<ul style="list-style-type: none">• 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 <i>M.S. in Communication Engineering (EECS Collage, Signal Processing for Communication Group)</i>	Taipei, Taiwan Feb. 2018 - June 2020
<ul style="list-style-type: none">• 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%) <i>B.S. in Electrical and Computer Engineering (Graduated early for academic excellence)</i>	Hsinchu, Taiwan Sept. 2014 - Jan. 2018

INTERNSHIP EXPERIENCE

Audio R&D Intern, Qualcomm <i>Designed and analyzed adaptive active noise cancellation (ANC) algorithms for wearables and AR audio systems.</i>	San Diego, CA Summer 2025
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RESEARCH EXPERIENCE

Online learning, prediction, and nonstochastic control <i>Research Assistant, supervised by Prof. Yang Zheng</i>	Sept. 2024 -
<ul style="list-style-type: none">• Designed and analyzed algorithms for <i>online time-series prediction</i> and <i>non-stochastic control</i> using tools from online convex optimization, <i>provably adapting</i> across three layers: <i>adversarial</i>, <i>nonstationary</i>, and <i>benign</i> environments• Developed <i>online predictive tracking</i> algorithms with <i>dynamic regret</i> guarantees for Koopman nonlinear systems	
Nonconvex nonsmooth policy optimization for optimal and robust control <i>Research Assistant, supervised by Prof. Yang Zheng</i>	Apr. 2023 -
<ul style="list-style-type: none">• Studied <i>optimization landscapes</i> of classical optimal and robust control from a modern policy optimization perspective• Developed the <i>Extended Convex Lifting</i> framework to reveal <i>hidden convexity</i> for various nonconvex control problems• Bridged policy optimization and classical Riccati and LMI-based approaches in robust <i>mixed $\mathcal{H}_2/\mathcal{H}_\infty$ control</i>• Analyzed <i>linear-quadratic differential game</i> through a <i>primal-dual lens</i> using semidefinite program formulations	
Reinforcement learning and general sequential decision-making <i>Research Assistant, supervised by Prof. Tara Javidi and Prof. Yian Ma</i>	June 2022 - March 2023
<ul style="list-style-type: none">• Designed algorithms for reward-free exploration in RL, focusing on active model estimation for Markov decision processes	
Signal processing for communication <i>Research Assistant, supervised by Prof. See-May Phoong</i>	June 2018 - Oct. 2020

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