

# 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

<b>University of California, San Diego (UCSD)</b> 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)
• <b>Research interest:</b> Optimization, control, online learning, and sequential decision-making	
• <b>Course:</b> Machine Learning, Statistical Learning, Planning & Learning in Robotics, Probabilistic Reasoning & Learning, Semidefinite & Sum-of-Squares Optimization, Continuous Optimization, Stochastic Approximation, Information Theory	
<b>National Taiwan University (NTU)</b> 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
• <b>Course:</b> Machine Learning, Deep Learning for Computer Vision, Matrix Computations, Convex Optimization, Design and Analysis of Algorithms, Adaptive/Multirate Signal Processing, Digital Communication	
<b>National Chiao Tung University (NCTU)</b> 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

## INTERN EXPERIENCE

<b>Audio R&amp;D Intern, Qualcomm</b> <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

<b>Online learning, prediction, and nonstochastic control</b> <i>Research Assistant, supervised by Prof. Yang Zheng</i>	Sept. 2024 -
• 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	
<b>Nonconvex nonsmooth policy optimization for optimal and robust control</b> <i>Research Assistant, supervised by Prof. Yang Zheng</i>	Apr. 2023 -
• 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 <math>\mathcal{H}_2/\mathcal{H}_\infty</math> control</i>	
• Analyzed <i>linear-quadratic differential game</i> through a <i>primal-dual lens</i> using semidefinite program formulations	
<b>Reinforcement learning and general sequential decision-making</b> <i>Research Assistant, supervised by Prof. Tara Javidi and Prof. Yian Ma</i>	June 2022 - March 2023
• Designed algorithms for <i>reward-free exploration</i> in RL, focusing on active model estimation for Markov decision processes	
<b>Signal processing for communication</b> <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*<sup>1</sup>
- C. Pai, Y. Tang, and Y. Zheng. *Policy Optimization of Mixed  $\mathcal{H}_2/\mathcal{H}_\infty$  Control: Benign Nonconvexity and Global Optimality*<sup>1</sup>
- 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.

<sup>1</sup>Manuscript has been submitted to Automatica

## HONORS

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- **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

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### UCSD, Department of Electrical and Computer Engineering

*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

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### 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

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