

Kai-Chieh Hsu

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I work on combining game-theoretic reasoning and machine learning techniques for safe human-centered robotic systems.

Research Interests

Machine Learning

Safe reinforcement learning (RL), adversarial RL and safe Sim2Real transfer

Human-Robot Interaction

Generative models and imitation learning for strategy and intent inference

Multi-Agent Planning

Game-theoretic counterfactual reasoning and iterative linear quadratic game

Education

Princeton University (PU)

Ph.D. Candidate in Electrical and Computer Engineering (ECE)

Princeton, NJ, USA

Sept. 2021 - June 2024 (EXPECTED)

M.A. in Electrical and Computer Engineering

Sept. 2019 - May 2021

- Concentration: Machine learning and Robotics
- Achieved 4.0/4.0 GPA
- Thesis Advisor: Prof. Jaime Fernández Fisac

National Taiwan University (NTU)

B.S. in Electrical Engineering (EE)

Taipei, Taiwan

Sept. 2014 - Jan. 2019

- Concentration: Signal processing and Digital IC design
- Achieved 4.19/4.30 overall GPA and ranked in **top 5%**
- Research Advisors: Prof. An-Yeu (Andy) Wu and Prof. Jean-Fu Kiang

Work Experiences

Engineering Intern

San Diego, CA

Qualcomm Technologies Inc. (Manager: [Stephen Chaves](#), Mentor: [Pranav Desai](#))

May 2023 - Aug. 2023

- Proposed a unified neural backbone for agent predictor and behavior planner in autonomous vehicles software stack
- Used reinforcement learning and imitation learning for implementing behavior planners

Research Scientist Intern [C2]

Remote

NVIDIA Corporation (Manager: [Prof. Marco Pavone](#), Mentor: [Prof. Karen Leung](#), [Yuxiao Chen](#))

May 2022 - Dec. 2022

- Formalized **responsibility** by safety margin decrease and policy shift with **counterfactual reasoning**
- Estimated the responsibility level online with **hidden Markov model**
- Incorporated the estimated responsibility into **trajectory prediction** models

Selected Publications

Journal Papers

- [J1] **K.-C. Hsu**, Haimin Hu, and J. F. Fisac, [The Safety Filter: A Unified View of Safety-Critical Control in Autonomous Systems](#), in *Annual Review of Control, Robotics, and Autonomous Systems*, (preprint).
- [J2] A. R. Kumar, **K.-C. Hsu**, P. J. Ramadge, and J. F. Fisac, [Fast, Smooth, and Safe: Implicit Control Barrier Functions through Reach-Avoid Differential Dynamic Programming](#), in *IEEE Control Systems Letters*, vol. 7, pp. 2994-2999, June 2023.
- [J3] **K.-C. Hsu**^{*}, A. Z. Ren^{*}, D. P. Nguyen, A. Majumdar⁺, and J. F. Fisac⁺, [Sim-to-Lab-to-Real: Safe Reinforcement Learning with Shielding and Generalization Guarantees](#), in *Artificial Intelligence*, Jan 2023. | Spotlight in [ICLR Workshop](#) and [NeurIPS Workshop](#)
- [J4] C.-Y. Chou, **K.-C. Hsu**, B.-H. Cho, K.-C. Chen, and A.-Y. (Andy) Wu, [Low-Complexity On-demand Reconstruction for Compressively Sensed Problematic Signals](#), in *IEEE Transactions Signal Processing*, vol. 68, pp. 4094-4107, July 2020.

Conference Papers

- [C1] H. Hu, K. Nakamura, **K.-C. Hsu**, N. E. Leonard, and J. F. Fisac, **Emergent Coordination through Game-Induced Nonlinear Opinion Dynamics**, in *Proc. IEEE Conf. Decision and Control*, Singapore, Dec 2023.
- [C2] **K.-C. Hsu**, K. Leung, Y. Chen, J. F. Fisac, and M. Pavone, Interpretable Trajectory Prediction for Autonomous Vehicles via Counterfactual Responsibility, in *IEEE/RSJ Int. Conf. Intelligent Robots & Systems*, Detroit, MI, USA, Oct 2023.
- [C3] **K.-C. Hsu**^{*}, D. P. Nguyen^{*}, and J. F. Fisac, **ISAACS: Iterative Soft Adversarial Actor-Critic for Safety**, in *Learning for Dynamics & Control*, Philadelphia, PA, USA, Jun 2023.
- [C4] S. Narain, D. Chee, P. Iyer, E. Mak, R. Valdez, M. Zhu, N. Jha, J. F. Fisac, **K.-C. Hsu**, P. Terway, K. Pochiraju, B. Englot, E. Pitz, S. Rooney, and Y. Huang, **AIMED: AI-Mediated Exploration of Design: An Experience Report**, in *Proc. IEEE Workshop on Design Automation for CPS and IoT*, San Antonio, TX, USA, May 2023.
- [C5] H. Chen, **K.-C. Hsu**, W. Turner, P.-H. Wei, K. Zhu, D. Pan, and H. Ren, **Reinforcement Learning Guided Detailed Routing for FinFET Custom Circuits**, in *Proc. Int. Symp. Physical Design*, Virtually, Mar 2023.
- [C6] **K.-C. Hsu**^{*}, V. Rubies-Royo^{*}, C. J. Tomlin, and J. F. Fisac, **Safety and Liveness Guarantees through Reach-Avoid Reinforcement Learning**, in *Proc. Robotics: Science and Systems*, Virtually, July 2021.

Honors & Awards

SEAS Travel Grant

SEAS, PU, NJ, USA
Nov. 2022

Teaching Assistant Award

- For the new *Intelligent Robotic Systems* course


Dept. of ECE, PU, NJ, USA
Sept. 2022

3rd Prize in Integrated Circuit Design Contest

- Out of about 300 teams

Ministry of Education, Taiwan
July 2018

2nd Prize in Taiwan Creative Electromagnetic Implementation Competition

- Under the supervision of Prof. Tzong-Lin Wu | 

High-speed RF and mm-Wave Tech. Center, Taiwan
Aug. 2017

8th place in Data Structure and Programming Contest

- Out of about 250 students

Cadence, Taiwan
Mar. 2017

Graduate Representative in NTUEE graduate ceremony

- Given to top ten students of four years

Dept. of EE, NTU, Taiwan
June 2018

Professor Chun-Hsiung Chen Scholarship

- Rewarded outstanding performances in electromagnetic fields

Electromagnetic Industry-Academia Consortium, Taiwan
Jan. 2018

Presidential Awards

- Given to top ten students of that semester

Dept. of EE, NTU, Taiwan
second semester of 2014 and 2016

Research & Teaching Experiences

Teaching Assistant

ECE346/566: Intelligent Robotic Systems, Prof. Jaime Fernández Fisac
ELE364: Machine Learning for Predictive Data Analytics, Prof. Niraj Jha

PU, NJ, USA
Jan. 2022 - May 2022
Sept. 2020 - Dec. 2020

Research Assistant

Access IC Lab, Prof. An-Yeu (Andy) Wu
Group of Electromagnetic Applications, Prof. Jean-Fu Kiang

NTU, Taiwan
Feb. 2018 - Mar. 2019
Feb. 2017 - Mar. 2019

Teaching Assistant

Digital System Design

NTU, Taiwan
Feb. 2018 - June 2018

Professional Activities

Reviewer

Artificial Intelligence, IEEE RA-L, IEEE OJCS, IEEE TVT, IEEE TSP, IJRR, ICRA, L4DC, AAAI, CDC

Program Committee

NeurIPS Workshop on **Human in the Loop Learning** and **Trustworthy Embodied AI**

Skills

Program Languages

Python, MATLAB, Verilog, C++

Others

PyTorch, Jax, Git, SLURM, NumPyro, CVX, \LaTeX

References

Jaime Fernández Fisac	Assistant Professor, Electrical and Computer Engineering, Princeton University jfisac@princeton.edu
Anirudha Majumdar	Assistant Professor, Mechanical and Aerospace Engineering, Princeton University ani.majumdar@princeton.edu
Karen Leung	Assistant Professor, Aeronautics & Astronautics, University of Washington Research Scientist, Autonomous Vehicle Research, NVIDIA kymleung@uw.edu
Peter Ramadge	Professor, Electrical and Computer Engineering, Princeton University ramadge@princeton.edu
Jie Tan	Staff Research Scientist, Google Deepmind jietan@google.com
Stephen Chaves	Senior Staff Engineer, Qualcomm Research schaves@qti.qualcomm.com