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)
Princeton, NJ, USA

Ph.D. Candidate in Electrical and Computer Engineering (ECE) — 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)
Taipei, Taiwan

B.S. in Electrical Engineering (EE) — 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

- Use reinforcement learning and imitation learning for behavior planners in autonomous vehicles

Research Scientist Intern [P2]
Remote

NVIDIA Corporation (Manager: Prof. Marco Pavone, Mentor: Prof. Karen Leung, Yuxiao Chen) — May 2022 - Dec. 2022

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

Publications

Preprint

[P1] Haimin Hu, Kensuke Nakamura, **K.-C. Hsu**, Naomi Ehrich Leonard, Jaime F. Fisac, Emergent Coordination through Game-Induced Nonlinear Opinion Dynamics, submitted to *IEEE Conference on Decision and Control (CDC),* Mar 2023.

[P2] **K.-C. Hsu**, Karen Leung, Yuxiao Chen, Jaime F. Fisac, Marco Pavone, Interpretable Trajectory Prediction for Autonomous Vehicles via Counterfactual Responsibility, submitted to *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS),* Feb 2023.

Journal Papers

[J1] Athindran Ramesh Kumar, **K.-C. Hsu**, Peter J. Ramadge, Jaime F. Fisac, Fast, Smooth, and Safe: Implicit Control Barrier Functions through Reach-Avoid Differential Dynamic Programming, in *IEEE Control Systems Letters,* June 2023.

[J2] **K.-C. Hsu**[*], Allen Z. Ren[*], Duy P. Nguyen, Anirudha Majumdar[+], and Jaime 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

[J3] 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 Trans. Signal Process.,* vol. 68, pp. 4094-4107, July 2020.

[J4] **K.-C. Hsu** and J.-F. Kiang, Joint Estimation of DOA and Frequency From A Mixture of Frequency Known and Unknown Sources with Orthogonal Coprime Arrays, in *Sensors, 19(2), 335,* Jan. 2019.

Conference Papers

[C1] **K.-C. Hsu**[*], Duy P. Nguyen[*], and Jaime F. Fisac, ISAACS: Iterative Soft Adversarial Actor-Critic for Safety, in *Proceedings of the 5th Annual Learning for Dynamics and Control Conference (L4DC),* Philadelphia, PA, USA, Jun 2023.

[C2] 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, Y. Huang, AIMED: AI-Mediated Exploration of Design: An Experience Report, in *Proceedings of the IEEE Workshop on Design Automation for CPS and IoT (DESTION),* San Antonio, TX, USA, May 2023.

[C3] 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 *Proceedings of the International Symposium on Physical Design (ISPD),* Virtually, Mar 2023.

[C4] **K.-C. Hsu**[*], V. Rubies-Royo[*], C. J. Tomlin and J. F. Fisac, Safety and Liveness Guarantees through Reach-Avoid Reinforcement Learning, in *Proceedings of Robotics: Science and Systems (RSS),* Virtually, July 2021.

[C5] **K.-C. Hsu**[*], B.-H. Cho[*], C.-Y. Chou and A.-Y. (Andy) Wu, Low-Complexity Compressed Analysis in Eigenspace with Limited Labeled Data for Real-Time Electrocardiography Telemonitoring, in *Proceedings of the IEEE Global Conference on Signal and Information Processing (GlobalSIP),* Anaheim, CA, USA, Nov 2018.

Honors & Awards

SEAS Travel Grant — SEAS, PU, NJ, USA — Nov. 2022

Teaching Assistant Award — Dept. of ECE, PU, NJ, USA — Sept. 2022
- For the new *Intelligent Robotic Systems* course

3rd Prize in Integrated Circuit Design Contest — Ministry of Education, Taiwan — July 2018
- Out of about 300 teams

2nd Prize in Taiwan Creative Electromagnetic Implementation Competition — High-speed RF and mm-Wave Tech. Center, Taiwan — Aug. 2017
- Under the supervision of Prof. Tzong-Lin Wu |

8th place in Data Structure and Programming Contest — Cadence, Taiwan — Mar. 2017
- Out of about 250 students

Graduate Representative in NTUEE graduate ceremony — Dept. of EE, NTU, Taiwan — June 2018
- Given to top ten students of four years

Professor Chun-Hsiung Chen Scholarship — Electromagnetic Industry-Academia Consortium, Taiwan — Jan. 2018
- Rewarded outstanding performances in electromagnetic fields

Presidential Awards — Dept. of EE, NTU, Taiwan — second semester of 2014 and 2016
- Given to top ten students of that semester

Research & Teaching Experiences

Teaching Assistant — PU, NJ, USA
ECE346/566: Intelligent Robotic Systems, Prof. Jaime Fernández Fisac — Jan. 2022 - May 2022
ELE364: Machine Learning for Predictive Data Analytics, Prof. Niraj Jha — Sept. 2020 - Dec. 2020

Research Assistant NTU, Taiwan
Access IC Lab, Prof. An-Yeu (Andy) Wu Feb. 2018 - Mar. 2019
Group of Electromagnetic Applications, Prof. Jean-Fu Kiang Feb. 2017 - Mar. 2019

Teaching Assistant NTU, Taiwan
Digital System Design Feb. 2018 - June 2018

Professional Activities

Reviewer Artificial Intelligence, IEEE Open Journal of Control Systems, IEEE Trans. on Vehicular Technology, IETE Technical Review, IEEE Trans. on Signal Processing, ICRA, L4DC

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