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
- 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 — 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 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
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Anirudha Majumdar Assistant Professor, Mechanical and Aerospace Engineering, Princeton University
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Karen Leung Assistant Professor, Aeronautics & Astronautics, University of Washington
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Peter Ramadge Professor, Electrical and Computer Engineering, Princeton University
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