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

Bede Liu Fund for Excellence — Dept. of ECE, PU, NJ, USA — Oct. 2023

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

Invited Talks

Creative Convergence Workshop — Princeton, NJ, USA — Oct, 2023
Title: Safe Learning-Based Control

Formal Methods Techniques in Robotics Systems: Design and Control — IROS, Detroit, MI, USA — Oct, 2023
Title: Role of Safety: from Safety-Critical Control to Safety-Informed Motion Forecasting

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, Automatica, 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
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