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,* 2024, (in press, preprint online).

[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] 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.

[C5] **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.

Under Review

[P1] **K.-C. Hsu***, D. P. Nguyen*, and J. F. Fisac, Gameplay Filters: Safe Robot Walking through Adversarial Imagination, Feb 2024.

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
- For the new *Intelligent Robotic Systems* course
Sept. 2022

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

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

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

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

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

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

Invited Talks

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

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

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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