

Kai-Chieh Hsu

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I combine game-theoretic reasoning and machine learning techniques to develop safe, human-centered robotic systems.

Experience

Machine Learning Research Scientist

Nuro Inc. (Manager: [Matt Sarett](#))

Mountain View, CA
July 2024 - PRESENT

Research Assistant

Princeton University, [Safe Robotics Laboratory](#) (Advisor: [Jaime Fernández Fisac](#))

Princeton, NJ
Aug. 2020 - May 2024

My work applies algorithmic and theoretical techniques from machine learning, control theory, and game theory to ensure the safety of learning-enabled autonomous systems. These algorithms scale to high-order dynamic systems and can handle complex deployment conditions. Additionally, they systematically unify the autonomy stack to prevent unwarranted conservativeness.

Engineering Intern

Qualcomm Research (Manager: [Stephen Chaves](#), Mentor: [Pranav Desai](#))

San Diego, CA
May 2023 - Aug. 2023

I Proposed a **unified neural backbone** for agent predictor and behavior planner in autonomous vehicles software stack and used reinforcement learning and imitation learning for implementing behavior planners.

Research Scientist Intern

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

Remote
May 2022 - Dec. 2022

I Formalized **responsibility** by safety margin decrease and policy shift with **counterfactual reasoning** and estimated the responsibility level online with **hidden Markov model**. I incorporated the estimated responsibility into **trajectory prediction** models to improve prediction accuracy and interpretability.

Education

Princeton University

Ph.D. in Electrical and Computer Engineering
M.A. in Electrical and Computer Engineering

Princeton, NJ
Sept. 2021 - May 2024
Sept. 2019 - May 2021

- Concentration: Machine learning and Robotics
- 4.0/4.0 GPA
- Advisor: Prof. Jaime Fernández Fisac
- Thesis: [Scaling Full-Stack Safety for Learning-Enabled Robot Autonomy](#)

National Taiwan University

B.S. in Electrical Engineering

Taipei, Taiwan
Sept. 2014 - Jan. 2019

- Concentration: Signal processing and Digital IC design
- 4.19/4.30 GPA and ranked in **top 10** of the class
- Research Advisors: Prof. An-Yeu (Andy) Wu and Prof. Jean-Fu Kiang

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*, Feb 2024.
- [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.

Awards and Honors

Hon Hai Technology Award

Rewarding outstanding performance in robotics

Hon Hai Education Foundation, Taiwan
June 2024

Bede Liu Fund for Excellence

Princeton University, NJ
Oct. 2023, Mar. 2024

Travel Grant

From the School of Engineering and Applied Science

Princeton University, NJ
Nov. 2022


Teaching Assistant Award

For the new *Intelligent Robotic Systems* course

Princeton University, NJ
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 Cadence Data Structure and Programming Contest
Out of about 250 students

Taipei, Taiwan
Mar. 2017

Graduate Representative

Top ten students in the Department of Electrical Engineering

National Taiwan University, Taiwan
June 2018

Professor Chun-Hsiung Chen Scholarship

Rewarding outstanding performance in electromagnetic research

Electromagnetic Industry-Academia Consortium, Taiwan
Jan. 2018

Dean's List

National Taiwan University, Taiwan
June 2014, June 2016

Invited Talks

USC, Safe and Intelligent Autonomy Lab

Title: Scaling Systematic Safety for Learning-Enabled Robot Autonomy

Los Angeles, CA
Mar. 2024

Creative Convergence Workshop

Title: Safe Learning-Based Control

Princeton, NJ
Oct. 2023

IROS Workshop on Formal Methods Techniques in Robotics Systems: Design and Control

Title: Role of Safety: from Safety-Critical Control to Safety-Informed Motion Forecasting

Detroit, MI
Oct. 2023

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