Haimin Hu

Contact Information

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Research Interests

My vision is to enable human-centered robotic systems that can be deployed, verified, and trusted. I work on new algorithms and theorems centered around dynamic game theory, integrating insights from control systems safety, numerical optimization, deep reinforcement learning, and generative AI. The core of my research is to close the interaction and learning loop by imbuing the robot's decision model with a representation of its own evolving uncertainty as well as that of others.

Professional Positions

Johns Hopkins University, Baltimore, MD — 2026
Assistant Professor, Department of Computer Science

University of Pennsylvania, Philadelphia, PA — 2025 - 2026
Postdoctoral Scholar, Department of Electrical and Systems Engineering

Toyota Research Institute, Cambridge, MA — 2023
PhD Research Intern, Human-Interactive Driving Team

Honda Research Institute USA, Inc., San Jose, CA — 2022
PhD Research Intern

National Institute for Nuclear Physics & University of Padova, Padova, Italy — 2017
Machine Learning Research Intern

Education

Princeton University, Princeton, NJ
Ph.D. & M.A. in Electrical and Computer Engineering — 2020 - 2025
Advisor: Jaime Fernández Fisac
Main collaborators: Naomi Ehrich Leonard, Bartolomeo Stellato, Andrea Bajcsy
Thesis: Game-Theoretic Integration of Safety and Learning for Human-Centered Robotics

University of Pennsylvania, Philadelphia, PA
M.S.E. in Electrical Engineering — 2018 - 2020
Advisors: George Pappas, Manfred Morari, Nikolai Matni

University of California, Berkeley, Berkeley, CA
Visiting student in Electrical Engineering and Computer Sciences — 2017 - 2018
Advisor: Claire Tomlin

ShanghaiTech University, Shanghai, China
B.E. in Electronic and Information Engineering — 2014 - 2018
Advisor: Boris Houska

Honors and Awards

RSS Pioneer — RSS Foundation, 2025
"30 world's top early-career researchers in robotics."

CPS Rising Star — NSF, 2025
"30 outstanding PhD students and postdocs in Cyber-Physical Systems (CPS)."

HRI Pioneer — ACM/IEEE, 2024
"25 world's top student researchers in human–robot interaction (HRI)."

Roberto Tempo Best CDC Paper Nominee — IEEE Control Systems Society, 2024

Best Presentation Award — RSS Safe Autonomy Workshop, 2024

Best Poster Award Workshop on Optimization, Learning, and Control, 2024

Outstanding Presentation Award Princeton Research Day, 2024

Outstanding Research Award University of Pennsylvania, 2020
Awarded to 2 electrical engineering masters.

Outstanding Graduate Shanghai Municipal Education Commission, 2018

President's Scholarship ShanghaiTech University, 2017

Merit Student for Excellence in Research ShanghaiTech University, 2017
Awarded to 1 undergraduates across all majors.

Scholarship for Academic Excellence ShanghaiTech University, 2015

Funding

Toyota Research Institute (TRI) University Research Program TRI, 2024 - 2026
Main proposal writer (PIs: Profs. Jaime Fisac and Naomi Leonard), Grant total: $754,000

ICRA Travel Support IEEE RAS, 2025

Bede Liu Fund for Excellence (Travel Grant) Princeton University, 2022 - 2025

WAFR Travel Grant NSF & IFRR, 2022, 2024

Toby and Jack Wolf Travel Grant Princeton University, 2022

First Year Fellowship in Natural Sciences and Engineering Princeton University, 2020 - 2021

GAPSA Professional Travel Grant University of Pennsylvania, 2018

Scholarship for Overseas Study ShanghaiTech University, 2016 - 2018

Conference Publications

[C16] D. D. Oh*, J. Lidard*, **H. Hu**, H. Sinhmar, E. Lazarski, D. Gopinath, E. Sumner, J. DeCastro, G. Rosman, N. E. Leonard, J. F. Fisac. Safety with Agency: Human-Centered Safety Filter with Application to AI-Assisted Motorsports, *Robotics: Science and Systems (RSS)*, 2025.

[C15] **H. Hu**, J. F. Fisac, N. E. Leonard, D. Gopinath, J. DeCastro, G. Rosman. Think Deep and Fast: Learning Neural Nonlinear Opinion Dynamics from Inverse Dynamic Games for Split-Second Interactions, *IEEE International Conference on Robotics and Automation (ICRA)*, 2025.

[C14] J. Wang*, **H. Hu***, D. P. Nguyen, and J. F. Fisac. MAGICS: Adversarial RL with Minimax Actors Guided by Implicit Critic Stackelberg for Convergent Neural Synthesis of Robot Safety, *Algorithmic Foundations of Robotics (WAFR) XVI*, 2024.

[C13] **H. Hu***, G. Dragotto*, Z. Zhang, K. Liang, B. Stellato, and J. F. Fisac. Who Plays First? Optimizing the Order of Play in Stackelberg Games with Many Robots, *Robotics: Science and Systems (RSS)*, 2024.

[C12] J. Lidard*, **H. Hu***, A. Hancock, Z. Zhang, A. G. Contreras, V. Modi, J. DeCastro, D. Gopinath, G. Rosman, N. E. Leonard, M. Santos, and J. F. Fisac. Blending Data-Driven Priors in Dynamic Games, *Robotics: Science and Systems (RSS)*, 2024.

[C11] **H. Hu***, Z. Zhang*, K. Nakamura, A. Bajcsy, and J. F. Fisac. Deception Game: Closing the Safety-Learning Loop in Interactive Robot Autonomy, *Conference on Robot Learning (CoRL)*, 2023. **Best Presentation Award** at the 2024 RSS Safe Autonomy Workshop.

[C10] **H. Hu**, K. Nakamura, K. Hsu, N. E. Leonard, and J. F. Fisac. Emergent Coordination Through Game-Induced Nonlinear Opinion Dynamics, *IEEE Conference on Decision and Control (CDC)*, 2023. **Nominated for the Roberto Tempo Best CDC Paper Award.**

[C9] **H. Hu** and J. F. Fisac. Active Uncertainty Reduction for Human-Robot Interaction: An Implicit Dual Control Approach, *Algorithmic Foundations of Robotics (WAFR) XV*, 2022. **Invited extension for IJRR special issue.**

* indicates equal contribution.

[C8] L. Lindemann, **H. Hu**, A. Robey, H. Zhang, D. V. Dimarogonas, S. Tu, and N. Matni. Learning Hybrid Control Barrier Functions from Data, *Conference on Robot Learning (CoRL)*, 2020.

[C7] **H. Hu**, M. Fazlyab, M. Morari, and G. J. Pappas. Reach-SDP: Reachability Analysis of Closed-Loop Systems with Neural Network Controllers via Semidefinite Programming, *IEEE Conference on Decision and Control (CDC)*, 2020.

[C6] A. Robey*, **H. Hu***, L. Lindemann, H. Zhang, D. V. Dimarogonas, S. Tu, and N. Matni. Learning Control Barrier Functions from Expert Demonstrations, *IEEE Conference on Decision and Control (CDC)*, 2020.

[C5] **H. Hu**, K. Gatsis, M. Morari, and G. J. Pappas. Non-Cooperative Distributed MPC with Iterative Learning, *21st IFAC World Congress*, 2020.

[C4] **H. Hu**, K. Gatsis, M. Morari, and G. J. Pappas. Tuning Communication Latency for Distributed Model Predictive Control, *IFAC Conference on Networked Systems (NecSys)*, 2019.

[C3] X. Feng, **H. Hu**, M. E. Villanueva, and B. Houska. Min-Max Differential Inequalities for Polytopic Tube MPC, *American Control Conference (ACC)*, 2019.

[C2] **H. Hu**, Y. Pu, M. Chen, and C. J. Tomlin. Plug and Play Distributed Model Predictive Control for Heavy Duty Vehicle Platooning and Interaction with Passenger Vehicles, *IEEE Conference on Decision and Control (CDC)*, 2018.

[C1] **H. Hu**, X. Feng, R. Quirynen, M. E. Villanueva, and B. Houska. Real-Time Tube MPC Applied to a 10-State Quadrotor Model, *American Control Conference (ACC)*, 2018.

Journal Publications

[J4] **H. Hu**, D. Isele, S. Bae, and J. F. Fisac. Active Uncertainty Reduction for Safe and Efficient Interaction Planning: A Shielding-Aware Dual Control Approach, *The International Journal of Robotics Research (IJRR)*, 2023.

[J3] K. Hsu, **H. Hu**, and J. F. Fisac. The Safety Filter: A Unified View of Safety-Critical Control in Autonomous Systems, *Annual Review of Control, Robotics, and Autonomous Systems*, 2023.

[J2] **H. Hu**, K. Nakamura, and J. F. Fisac. SHARP: Shielding-Aware Robust Planning for Safe and Efficient Human-Robot Interaction, *IEEE Robotics and Automation Letters (RA-L)*, 2022.

[J1] M. Chen*, S. L. Herbert*, **H. Hu**, Y. Pu, J. F. Fisac, S. Bansal, S. Han, and C. J. Tomlin. FaSTrack: A Modular Framework for Real-Time Motion Planning and Guaranteed Safe Tracking, *IEEE Transactions on Automatic Control (TAC)*, 2021.

Preprints

[P1] K. Liang, **H. Hu**, R. Liu, T. L. Griffiths, and J. F. Fisac. RLHS: Mitigating Misalignment in RLHF with Hindsight Simulation, 2024.

Teaching

Safety-Critical Robotic Systems (Graduate) Princeton University, Fall 2021, 2022
Head Assistant in Instruction; Delivered a guest lecture on robust planning; Instructor: Jaime F. Fisac

Model Predictive Control (Graduate) University of Pennsylvania, Spring 2020
Head Teaching Assistant; Delivered a guest lecture on invariant sets; Instructor: Manfred Morari

Science and Art Summer School (Undergraduate) University of Padova, Summer 2024
Lecturer in Robotics; Taught human–robot interaction; Course Director: Ernesto Carafoli

Invited Talks

UPenn GRASP Student Faculty Industry (SFI) Seminar 2025
Johns Hopkins University, CS, ECE & LCSR Joint Seminar 2025
Duke University, MEMS Department Seminar 2025
Texas A&M University, CS & ECE Joint Seminar 2025
George Washington University, MAE Department Seminar 2025
University of Colorado Boulder, ECEE Department Seminar 2025

North Carolina State University, ECE Department Seminar 2025
UCSD Safe Autonomous Systems Lab 2024
From Gambits to Assurances: Game-Theoretic Integration of Safety and Learning for Human-Centered Robotics

IEEE CDC Workshop on Bifurcations for Control 2024
Constructing Nonlinear Opinion Dynamics for Split-Second Game-Theoretic Interactions

Scania CV AB | KTH Royal Institute of Technology 2024
The Safety Filter: A Unified View of Safety-Critical Control in Autonomous Systems

University of Padova Science and Art Summer School 2024
Robotics: Toward Safer and More Efficient Interaction with Humans

Northeast Systems and Control Workshop 2024
Human-Aware Safety Filters: A Unified View of Safety-Critical Control, Learning, and Interaction

UPenn Vijay Kumar Lab | CMU Safe AI Lab | UIUC Human-Centered Autonomy Lab 2024
Who Plays First? Optimizing the Order of Play in Stackelberg Games with Many Robots

Creative Convergence Workshop 2023
Nonlinear Opinion Dynamics Meets Game Theory: Split-second Decisions for Interactive Robotics

Toyota Research Institute 2023
Learning to Break Indecisions in Multi-Agent Interaction

University of Colorado Boulder | Honda Research Institute USA, Inc. 2022
Active Uncertainty Reduction for Human–Robot Interaction

Princeton University, Robotics Seminar 2021
Shielding-Aware Robust Planning for Safe and Efficient Human–Robot Interaction

ETH Zürich, Institute for Dynamic Systems and Control 2020
Distributed Model Predictive Control for the Internet-of-Things

University of Pennsylvania, Department of Electrical and Systems Engineering 2018
Plug and Play Distributed MPC for Heavy Duty Vehicle Platooning

Chinese Academy of Sciences, Shanghai Branch 2018
Real-time Tube-based Model Predictive Control

UC Berkeley, Hybrid Systems Laboratory 2017
Model Predictive Control for Fast and Guaranteed Safe Motion Planning

Advising and Mentorship

PhD students
Donggeon David Oh (PhD student at Princeton ECE)
Justin Wang (PhD student at Princeton ECE)
Madison Bland (PhD student at Princeton ECE)

Master's students
Albert Gimó Contreras (visiting student at Princeton, recipient of the **"La Caixa" Fellowship**)
Xinyi Liu (UMich/Honda Research Institute → PhD at UNC/NCSU Joint Department of BME)

Undergraduate students
Kensuke Nakamura (Princeton ECE → PhD student at CMU)

Vikash Modi (Princeton ECE → SpaceX)
Elle Lazarski (Princeton ECE)

Outreach

Program Co-organizer, Princeton AI4ALL 2022 - 2024
The summer camp teaches AI technology and policy to high school students from diverse backgrounds, to broaden access to AI and inspire our future leaders to use it ethically.

Lecturer in Robotics, University of Padova Science and Art Summer School 2024
The summer school offers broad topics in science and art to undergraduate students from diverse backgrounds.

Open-source Software

BranchAndPlay: An efficient solver that finds the socially-optimal Stackelberg (leader-follower) equilibrium for general-sum dynamic games.

KLGame: An efficient solver for non-cooperative dynamic games with Kullback-Leibler (KL) regularization with respect to a general, stochastic, and possibly multi-modal reference policy.

DeceptionGame: Approximate HJI Reachability analysis for robot safety in joint physical–belief spaces using adversarial reinforcement learning.

OpinionGame: Automatic synthesis of nonlinear opinion dynamics using dynamic games.

JaxRacing: JAX-based implementation of ILQR for safe autonomous racing.

DualControlHRI: Active uncertainty reduction for human–robot interaction using dual control.

SHARP: A human-aware motion planner that preempts costly safety-enforcing maneuvers triggered by unlikely human actions.

LearningCBFs: Learning a provably valid control barrier function (CBF) from expert data.

Media Coverage

Data drives quicker, safer decisions for race cars and robots Princeton EQuad News, 2024
Who plays first? Using game theory to coordinate many robots Princeton Research, 2024

Professional Activities

Associate Editor

- IEEE Robotics and Automation Letters (RA-L) 2024 - 2027

Workshop & Seminar Organization

- ICRA Workshop on Public Trust in Autonomous Systems, Main Organizer 2024
- HRI Pioneers, Program Chair 2024
- Princeton Robotics Seminar, Main Organizer 2024 - 2025

External Reviewer for Journals

- International Journal of Robotics Research (IJRR)
- IEEE Transactions on Robotics (T-RO)
- Automatica
- IEEE Transactions on Automatic Control (TAC)
- IEEE Transactions on Control Systems Technology (TCST)
- IEEE Transactions on Control of Network Systems (TCNS)
- IEEE Robotics and Automation Letters (RA-L)
- IEEE Control Systems Letters (L-CSS)
- International Journal of Robust and Nonlinear Control
- Optimal Control Applications and Methods

- IET Control Theory & Applications
- Chemical Engineering Science
- IEEE Access

External Reviewer for Conferences and Workshops

- Robotics: Science and Systems (RSS)
- Conference on Robot Learning (CoRL)
- Algorithmic Foundations of Robotics (WAFR)
- IEEE International Conference on Robotics and Automation (ICRA)
- IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)
- IEEE Conference on Decision and Control (CDC)
- American Control Conference (ACC)
- IFAC World Congress
- Annual Learning for Dynamics & Control Conference (L4DC)
- International Conference on Neuro-symbolic Systems (NeuS)
- IFAC Conference on Networked Systems (NecSys)
- Annual Conference on Information Sciences and Systems (CISS)
- RSS Safe Autonomy Workshop
- ICRA Workshop on Bridging the Lab-to-Real Gap