Sylvia Herbert | Curriculum Vitae

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I am an Assistant Professor of Mechanical and Aerospace Engineering at University of California, San Diego. I am also affiliated with Computer Science and Engineering as well as Electrical and Computer Engineering. My research focus is to enable efficient and safe decision-making in robots and other complex autonomous systems, while reasoning about uncertainty in real-world environments and human interactions. These techniques are backed by both rigorous theoretical guarantees and physical testing on robotic platforms.

Education

University of California, Berkeley
Ph.D., Electrical Engineering *2020*
Advisor: Claire J. Tomlin
Drexel University
B.S./M.S., Mechanical Engineering *2014*

Honors and Awards

2024: Selected for the Society of Hellman Fellows
2024: UCSD Engineering Early Faculty Development Award
2023: RoboCup Best Paper award at the IEEE Conference on Intelligent Robots and Systems (IROS)
2022: Office of Naval Research Young Investigator Program (ONR YIP) Award
2019: Selected for the Rising Stars in Electrical Engineering and Computer Sciences Program
2019: Selected for the Rising Stars in Mechanical Engineering Program
2019: Selected for the Future Digileaders Program at the KTH Royal Institue of Technology
2019: Selected for the Microsoft Research AI Breakthroughs Workshop
2018: Outstanding Graduate Student Instructor, UC Berkeley
2018: Outstanding Leadership Award Nomination, UC Berkeley
2018: Demetri Angelakos Memorial Achievement Award for Altruism, UC Berkeley
2018: Selected for the NextProf Workshop: Preparing the Next Generation of Technological Leaders
2018: Selected for the Robot Guru Mentorship Program at the Workshop on Algorithmic Foundations of Robotics
2018: Selected for the iREDEFINE Workshop: Improving the Diversity of Faculty in Electrical and Computer Engineering
2014: Chancellor's Fellowship, UC Berkeley
2014: Graduate Research Fellowship (NSF GRFP), National Science Foundation

Teaching

2021-2024: Special Topics: Safety for Autonomous Systems (Grad)
2023: Signals and Systems (UG)
2021-2024: Linear Feedback Control (UG)
2018: Teaching Assistant for Optimization Models in Engineering (Grad)
2017: Teaching Assistant for Linear Systems Theory (Grad)
2013: Teaching Assistant for Computer Aided Engineering Design (UG)

Students Mentored

Current Students:

PhD Students

- Nikhil Shinde (ECE), NSDEG Fellow, co-advised with Prof. Michael Yip
- Sander Tonkens (MAE), UCSD NISEC Fellow
- Zheng Gong (MAE)
- Will Sharpless (BME), UCSD Interfaces Fellow
- Boyang Li (MAE)
- Azra Begzadić (MAE), co-advised with Prof. Jorge Cortés
- Dylan Hirsh (MAE), NSF GFRP Fellow, co-advised with Prof. Boris Kramer

MS Students

- Chenhao Liu (MAE)
- Zihang (River) He (CSE)
- Marfred Barrera (MAE)

UG Students

- Matthew Kim (CSE)
- Hyun Joe Jeong (MAE)
- Sanat Samal (CSE)
- Colleen Wang (MAE)
- Yeiry Melendez (MAE)
- Charles Lahey (MAE)
- Kaleb Ugalde (MAE)

Graduated Students:

MS Students

- Ethan Foss (Now: PhD Student, Stanford University)
- Alex Toofanian (Now: Technical Program Manager, Braincorp)
- Chong He (Now: PhD Student, Simon Fraser University)
- Rachit Chhabra (Now: Engineer, Qualcomm Autonomous Driving R&D)
- Nathan Cusson-Nadeau (Now: Engineer, Alare Technologies LLC)

UG Students

- Judy Mohamad (Now: MS/PhD Student, Tokyo Tech)
- Sosuke Kojima (Now: MS Student, ETH Zurich)
- Daniel Maldonado-Naranjo (Now: PhD Student, MIT)
- Zihang He (Now: MS Student, UCSD)

Outreach

2020-present: Mentoring under-represented and/or first-generation undergraduate students doing research in my lab through the following programs:

- Guided Engineering Apprenticeship in Research (GEAR)
- Summer Training Academy for Research Success (STARS)
- Triton Research and Experiential Learning Scholars (TRELS)

- Regents Scholarship Program
- PATHways to STEM through Enhanced Access and Mentorship (PATHS)
- Academic Community for Engineering Success (ACES)
- University of California Leadership Excellence through Advanced Degrees (UC LEADS)

2020-2021: Mentor, Inclusion@RSS Program
2017-2020: Graduate Mentor, Society of Women Engineers
2018-2020: Graduate Mentor, Women in CS and Engineering
2018-2020: Chair, Electrical Engineering and Computer Science Peer Mentorship Program, UC Berkeley
2017-2020: Chair, Electrical Engineering and Computer Science Wellness Committee, UC Berkeley

Service

2023: Publication Chair, Robotics: Science and Systems (RSS) 2023
2021-2023: IEEE Robotics and Automation Society (RAS) Women in Engineering (WiE) Committee
2020-2022: ICRA Workshop Lead Organizer: Debates on the Future of Robotics Research
2021-2022: Lead Organizer, Center for Control Systems and Dynamics Seminar Series, UCSD
2019-2020: RSS Workshop Organizer: Robust Autonomy, Safety in Uncertain Environments
2017-2020: Lead Organizer, DREAM/CPAR Seminar Series, UC Berkeley
2017-2018: President, Electrical Engineering Graduate Student Association, UC Berkeley
2017: CDC Workshop Organizer: Tutorial on Hamilton-Jacobi Reachability Analysis

Review Activities

- IEEE Transactions on Robotics (TRO)
- IEEE Transactions on Automatic Control (TAC)
- International Journal of Robotics Research (IJRR)
- Automatica
- Robotics: Science and Systems (RSS)
- Journal of Artificial Intelligence Research (JAIR)
- IEEE Control Systems Letters (L-CSS)
- IEEE Robotics and Automation Magazine (RAM)
- IEEE Robotics and Automation Letters (RAL)
- IEEE International Conference on Decision and Control (CDC)
- Conference on Robot Learning (CoRL)
- IEEE International Conference on Robotics and Automation (ICRA)
- IEEE European Control Conference (ECC)

Invited Talks

Invited Keynotes
2021: IEEE Symposium on Multi-Robot and Multi-Agent Systems, Early Career Spotlight Talk

Invited Conference and Workshop Talks
2024: Information Theory and Applications (ITA) Workshop
2023: International Conference on Robotics and Automation (ICRA) Workshop on Bridging the Lab-to-Real Gap
2023: American Control Conference (ACC) Workshop on Human Autonomy Interaction and Integration
2022: UCLA Institute for Pure and Applied Mathematics (IPAM) Workshop on High-Dimensional Hamilton-Jacobi PDEs

2021: Intelligent Robots and Systems (IROS) Workshop on Cognitive and Social Aspects of Human Multi-Robot Interaction

Invited Seminar Talks

2024: UC Irvine Mechanical Engineering Seminar Series
2023: Spotlight talk, UCSD Contextual Robotics Forum
2023: Stanford Robotics Seminar Series
2023: USC Electrical Engineering Research Seminar Series
2023: UC Berkeley Semiautonomous Seminar Series
2023: University of Utah Robotics Seminar Series
2022: Stanford AI Safety Seminar Series
2022: Cornell Robotics Seminar Series
2022: ETH Zurich Autonomy Talks
2022: UC Irvine Robotics Seminar Series
2022: UC Riverside Applied Mathematics Seminar Series
2021: Microsoft Research NYC Seminar Series
2021: Princeton University, Guest Lecture for ECE 539: Safety-Critical Robotic Systems
2019: UW Aerospace Seminar Series
2019: Stanford Robotics Symposium
2019: Simon Fraser University Robotics Seminar Series
2019: University of British Columbia Collaborative Advanced Robotics and Intelligent Systems Lab Seminar
2019: CU Boulder Computer Science Colloquium

Software

HopfReach: linear time varying reachability analysis using the Hopf-Lax formulation.
refineCBF: framework for refining data-driven or hand-crafting control barrier function to reduce conservativeness and provide safety guarantees.
FaSTrack: robust planning and control framework compatible with the Open Motion Planning Library.
helperOC: optimal control toolbox, pairs with the toolbox of level set methods.

Publications

[1] Chong He et al. "Efficient and Guaranteed Hamilton-Jacobi Reachability via Self-Contained Subsystem Decomposition and Admissible Control Sets". In: *Control Systems Letters (L-CSS)*. IEEE. 2024.

[2] Hyun Joe Jeong et al. "Parameterized Fast and Safe Tracking (FaSTrack) using Deepreach". In: *Learning for Dynamics and Control (L4DC)*. 2024.

[3] Mohammad S Ramadan et al. "A Control Approach for Nonlinear Stochastic State Uncertain Systems with Probabilistic Safety Guarantees". In: *American Control Conference (ACC)*. IEEE. 2024.

[4] Nikhil U Shinde et al. "JIGGLE: An Active Sensing Framework for Boundary Parameters Estimation in Deformable Surgical Environments". In: *Robotics: Science and Systems (RSS)*. 2024.

[5] Tao Wang, Sylvia Herbert, and Sicun Gao. "Mollification Effects of Policy Gradient Methods". In: *International Conference on Machine Learning (ICML)*. 2024.

[6] Milan Ganai et al. "Iterative Reachability Estimation for Safe Reinforcement Learning". In: *Advances in Neural Information Processing Systems (NeurIPS)*. 2023.

[7] Nikhil U Shinde et al. "Object-Centric Representations for Interactive Online Learning with Non-Parametric Methods". In: *Conference on Automation Science and Engineering (CASE)*. IEEE. 2023.

[8] Tao Wang, Sylvia Herbert, and Sicun Gao. "Fractal Landscapes in Policy Optimization". In: *Advances in Neural Information Processing Systems (NeurIPS)*. 2023.

[9] Hongzhan Yu et al. "Sequential Neural Barriers for Scalable Dynamic Obstacle Avoidance". In: *International Conference on Intelligent Robots and Systems (IROS)*. IEEE. 2023.

[10] Zheng Gong et al. "Constructing Control Lyapunov-Value Functions Using Hamilton-Jacobi Reachability Analysis". In: *Control Systems Letters (L-CSS)*. IEEE. 2022.

[11] Sander Tonkens and Sylvia Herbert. "Refining Control Barrier Functions through Hamilton-Jacobi Reachability". In: *International Conference on Intelligent Robots and Systems (IROS)*. IEEE. 2022.

[12] Mo Chen et al. "Fastrack: a modular framework for real-time motion planning and guaranteed safe tracking". In: *Transactions on Automatic Control (TAC)*. IEEE. 2021.

[13] Jason J Choi et al. "Robust Control Barrier-Value Functions for Safety-Critical Control". In: *Conference on Decision and Control (CDC)*. IEEE. 2021.

[14] Sylvia Herbert et al. "Scalable Learning of Safety Guarantees for Autonomous Systems using Hamilton-Jacobi Reachability". In: *International Conference on Robotics and Automation (ICRA)*. IEEE. 2021.

[15] David Fridovich-Keil et al. "Confidence-aware motion prediction for real-time collision avoidance". In: *The International booktitle of Robotics Research (IJRR)*. 2020.

[16] Andrea Bajcsy et al. "A scalable framework for real-time multi-robot, multi-human collision avoidance". In: *International Conference on Robotics and Automation (ICRA)*. IEEE. 2019.

[17] Sylvia Herbert et al. "Reachability-based safety guarantees using efficient initializations". In: *Conference on Decision and Control (CDC)*. IEEE. 2019.

[18] Sara Pohland, Sylvia Herbert, and Claire Tomlin. "Efficient Safe Learning for Robotic Systems in Unstructured Environments". In: *International Conference on Mobile Ad Hoc and Sensor Systems Workshops (MASSW)*. IEEE. 2019.

[19] Vicenç Rubies-Royo et al. "A Classification-based Approach for Approximate Reachability". In: *International Conference on Robotics and Automation (ICRA)*. IEEE. 2019.

[20] Sumeet Singh et al. "Robust Tracking with Model Mismatch for Fast and Safe Planning: an SOS Optimization Approach". In: *Workshop on Algorithmic Foundations of Robotics (WAFR)*. 2019.

[21] Mo Chen et al. "Decomposition of reachable sets and tubes for a class of nonlinear systems". In: *Transactions on Automatic Control (TAC)*. IEEE. 2018.

[22] Jaime F Fisac et al. "Probabilistically Safe Robot Planning with Confidence-Based Human Predictions". In: *Robotics: Science and Systems (RSS)*. 2018.

[23] David Fridovich-Keil et al. "Planning, fast and slow: A framework for adaptive real-time safe trajectory planning". In: *International Conference on Robotics and Automation (ICRA)*. IEEE. 2018.

[24] Somil Bansal et al. "Hamilton-Jacobi reachability: A brief overview and recent advances". In: *Conference on Decision and Control (CDC)*. IEEE. 2017.

[25] Mo Chen, Sylvia Herbert, and Claire J Tomlin. "Exact and efficient Hamilton-Jacobi guaranteed safety analysis via system decomposition". In: *International Conference on Robotics and Automation (ICRA)*. IEEE. 2017.

[26] Sylvia Herbert et al. "FaSTrack: A modular framework for fast and guaranteed safe motion planning". In: *Conference on Decision and Control (CDC)*. IEEE. 2017.

[27] Mo Chen, Sylvia Herbert, and Claire J Tomlin. "Fast reachable set approximations via state decoupling disturbances". In: *Conference on Decision and Control (CDC)*. IEEE. 2016.

[28] Brandon Terranova et al. "Cylindrical channel plasmon resonance for single-molecule sensing". In: *Photonic and Phononic Properties of Engineered Nanostructures IV*. SPIE. 2014.

[29] David A Delaine, Sylvia Herbert, and Adam K Fontecchio. "An optical induction generator through Crooke's radiometer". In: *Novel Optical Systems Design and Optimization XIII*. SPIE. 2010.

[30] Rich Kressly et al. "Portable inspiration: The necessity of STEM outreach investment". In: *The Technology Teacher*. International Technology Education Association. 2009.

Grants

2024-2025: Selected Participant, **UCSD Naval Innovation, Science, and Engineering Center**, "Safe and Adaptable Contingency Planning for Unmanned Autonomous Naval Platforms"

2024-2025: Co-Principal Investigator, **UCSD Jacobs School of Engineering Early Career Faculty Award**, "Agile Safety: Learning-Enabled Reachability for Safe Multi-Agent Control"

2024-2025: Principal Investigator, **Society of Hellman Fellows**, "Safety Analysis and Control for Systems Biology Applications"

2023-2026: Co-Principal Investigator, **IHI Corporation**, "Human Workers – Robots Collaboration for Developing New Logistic Systems"

2022-2025: Principal Investigator, **Office of Naval Research (ONR) Young Investigator Program (YIP)**, "Constructing and Adapting Control Barrier Functions for Guaranteed Safe Control of Autonomous Systems using Hamilton-Jacobi Reachability,"

2021-2022: Principal Investigator, **Amazon Research Award**, "Safe and Efficient Robotic Control using Constructive and Adaptable Control Barrier Functions"