SooJean Han

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Education

California Institute of Technology (Caltech) Pasadena, CA, USA
Ph.D. Control and Dynamical Systems *Sep. 2017 - Jan. 2023*
Thesis Defense Video: [Link]

University of California, Berkeley (UC Berkeley) Berkeley, CA, USA
B.S. Electrical Engineering and Computer Science *Jun. 2014 - Dec. 2016*
B.S. Applied Mathematics *Jun. 2014 - Dec. 2016*

Work & Employment History

Korea Advanced Institute of Science & Technology (KAIST). Aug 2023 - present
Assistant Professor (School of Electrical Engineering).
Director and founder of the Autonomous Control for Stochastic Systems (ACSS) research laboratory, where we use mathematical theory and real-world applications to develop autonomous control, estimation, and decision-making algorithms, especially for stochastic systems.

California Institute of Technology (Caltech). Feb 2023 - Aug 2023
• *Postdoctoral Scholar.*
Autonomous Robotics and Control Lab (ARCL). Performed experiments for autonomous aerial visual navigation in low-light environments (e.g., night, heavy fog), and diffusion-based motion planning. Models were trained on thermal near-shore data curated by the lab. Supported by DARPA Learning in Control (LINC) and ONR.

• *Graduate Research Assistant.*
Doyle Lab and ARCL. Performed research broadly at the intersection of control theory and artificial intelligence. Concrete applications include stochastic systems, networks and distributed sensing, and autonomous decision-making. Supported by NSF GRFP.

NASA Jet Propulsion Laboratory (JPL). Jun 2018 - Aug 2018
Research Affiliate.
Involved with the DARPA Subterranean (SubT) Challenge as a part of Team CoSTAR. Implemented vision-based SLAM using C++ and deployed it on terrestrial rolling-walking hybrid robots custom-built by our team. Objective was to perform distributed collaborative mapping and merging using keypoint feature detection.

CAST, Caltech. Jun 2017 - Aug 2017
Research Assistant.
Center for Autonmous Systems & Technologies (CAST). Implemented distributed control over multiple Crazyflie quadrotor platforms for synchronization and formation-flight. The combined PID and nonlinear controllers were designed in Python and C++, and deployed through ROS and VICON motion capture.

University of California, Berkeley (UC Berkeley). Jan 2017 - May 2017
Undergraduate Research Assistant.
Hybrid Systems Lab. Developed and implemented obstacle detection for FaSTrack, a modular framework for autonomous path-planning. Relevant publications [here] and [here].

Publications

Academic Journals

- Published
  - **SooJean Han**, Soon-Jo Chung, and John C. Doyle. Predictive Control of Linear Discrete-Time Markovian Jump Systems by Learning Recurrent Patterns. *Automatica*, 156, May 2023. [Link]
  - **SooJean Han** and Soon-Jo Chung. Incremental Nonlinear Stability Analysis for Stochastic Systems Perturbed by Lévy Noise. *International Journal of Robust and Nonlinear Control*, 32(12):7174–7201, Aug 2022. [Link]
  - Shih-Hao Tseng, **SooJean Han**, and Adam Wierman. Trading Throughput for Freshness: Freshness-Aware Traffic Engineering and In-Network Freshness Control. *ACM Transactions on Modeling and Performance Evaluation of Computing Systems (ToMPECS)*, 8(4):1–26, Mar 2023. [Link]
  - Mo Chen, Sylvia L. Herbert, Haimin Hu, Ye Pu, Jaime Fernández Fisac, Somil Bansal, **SooJean Han**, and Claire J. Tomlin. FaSTrack:A Modular Framework for Real-Time Motion Planning and Guaranteed Safe Tracking. *IEEE Transactions on Automatic Control*, 66(12):5861–5876, Dec 2021. [Link]
- Preprints
  - **SooJean Han** and Soon-Jo Chung. A Two-Part Controller Synthesis Approach for Nonlinear Stochastic Systems Perturbed by Lévy Noise Using Renewal Theory and HJB-Based Impulse Control. ArXiv. Aug 2021. [Link]

Conferences

- Published
  - **SooJean Han**, Minwoo Kim, and Ieun Choo. A Stochastic Robust Adaptive Systems Level Approach to Stabilizing Large-Scale Uncertain Markovian Jump Linear Systems. In *IEEE 63rd Annual Conference on Decision and Control (CDC)*, Sep 2024. To appear
  - Mukul Chodhary, Kevin Octavian, and **SooJean Han**. Efficient Replay Memory Architectures in Multi-Agent Reinforcement Learning for Network Congestion Control. In *27th IEEE International Conference on Intelligent Transportation Systems (ITSC)*, Jul 2024. To appear
  - **SooJean Han**, Soon-Jo Chung, and Johanna Gustafson. Congestion Control of Vehicle Traffic Networks by Learning Structural and Temporal Patterns. In *Proceedings of The 5th Annual Learning for Dynamics and Control Conference*, volume 211 of *Proceedings of Machine Learning Research*, pages 903–914. PMLR, Jun 2023. [Link]
  - **SooJean Han**. Localized Learning of Robust Controllers for Networked Systems with Dynamic Topology. In *Proceedings of the 2nd Conference on Learning for Dynamics and Control (L4DC)*, volume 120 of *Proceedings of Machine Learning Research*, pages 687–696. PMLR, Jun 2020. [Link]
  - Shih-Hao Tseng, Carmen Amo Alonso, and **SooJean Han**. System Level Synthesis via Dynamic Programming. In *IEEE 59th Annual Conference on Decision and Control*, pages 1718–1725, Dec 2020. [Link]
  - Sylvia L. Herbert, Mo Chen, **SooJean Han**, Somil Bansal, Jaime F. Fisac, and Claire J. Tomlin. FaSTrack: A Modular Framework for Fast and Guaranteed Safe Motion Planning. In *IEEE 56th Annual Conference on Decision and Control (CDC)*, pages 1517–1522, Dec 2017. [Link]
- Preprints
  - Hyeongmin Choe and **SooJean Han**. Quantifying the Advantage of Feedback-Structured Distributed Data-Gathering for Accurate and Efficient State-Estimation. In *American Control Conference (ACC)*, Oct 2024. Under review
  - Jungyo Jung and **SooJean Han**. Predictive Switching Mode Control for Quadrotors with Fault Tolerance Against Rotor Failures. In *American Control Conference (ACC)*, Oct 2024. Under review
  - **SooJean Han**, Michelle Effros, and Richard M. Murray. OUTformation: Distributed Data Gathering with Feedback under Unknown Environment and Communication Delay Constraints. *ArXiv*, Aug 2022. [Link]
  - **SooJean Han**, Michelle Effros, and Richard M. Murray. Optimizing Accuracy and Efficiency using Feedback in Distributed Data Gathering of Uncertain Environments. Sep 2022. [Link]

Invited Seminars and Symposiums

Institute of Control Robotics and Systems (ICROS) Invited Talk Dec 2024
Presenting ACSS lab's current research towards the ultimate goal of achieving data-efficient AI and control, including 1) memory-efficient architectures for reinforcement learning, 2) predictive and anti-redundant multisensor fusion, and 3) robust and adaptive planning/control under uncertainties.

Korea Robotics Conference (KRoC) New Faculty Seminar Feb 2024
Invited presentation for new faculty research seminar. Presented several works on autonomous control based on learning patterns, and current and future directions.

Invited Seminar at KAIST Oct 2022
Presented research on stability analysis and learning-based control for two types of jump stochastic systems: nonlinear systems with Lévy noise and discrete-time Markovian jump systems. The controller framework learns patterns in the jump process to reduce redundant computation, and can be used in applications including the fault-tolerant control of networks with time-varying topology. Slides can be found [here].

39th SoCal Control Workshop Apr 2022
Presented a controller framework for a class of discrete-event systems based on a novel principle which learns patterns in the underlying event process. The framework reduces computation redundancy and time by using martingale theory to predict future occurrence times and probabilities of repeating patterns. Slides can be found [here]

Caltech CAST Poster Session Feb 2020
Presented a distributed data-gathering framework which uses processor-to-sensor feedback communication to reduce redundant data transmissions and sensor power consumption. Poster can be found [here].

Teaching & Mentoring Experience

Courses Taught at KAIST Aug 2023 - present

Semester	Course Number	Title	Class Size
Fall 2024	EE202	Signals and Systems	120
Spring 2024	EE581	Linear Systems	60
Fall 2023	EE488F	Learning Patterns for Autonomous Control	12 (self-created topics course)

Summer Undergraduate Research Fellow (SURF) Mentor Jun 2022 - Sep 2022
Mentored one SURF student in the Autonomous Robotics and Control Lab (ARCL) at Caltech. Project was about congestion control of vehicle traffic intersection networks via adaptive signals. Relevant paper [here], presented at L4DC'23).

Teaching Assistant for Optimal Control and State-Estimation Jan 2020 - Mar 2020
TA for CDS 112/Ae103a taught at Caltech during the Winter 2020 quarter. Provided lecture recitations and guest lectures on discrete and continuous-time Kalman filtering, particle filtering, the HJB equation, Euler-Lagrange equations, and the Pontryagin Maximum Principle. Created lecture notes for the course which can be found [here] and [here] (this one was made with students).

Summer Undergraduate Research Fellow (SURF) Mentor Jun 2017 - Aug 2017
Mentored two SURF students in the Autonomous Robotics and Control Lab (ARCL) at Caltech. Project was about synchronization and formation-flying for multi-agent networks of Crazyflie quadrotors.

Fellowships

NSF GRFP Jun. 2019 - Jun. 2022

Caltech Special EAS Fellowship Jun. 2017 - Jun. 2019

Peer Review Experience

Journal Articles

- 6 papers in IEEE Transactions on Automatic Control (TAC)
- 11 papers in IEEE Control Systems Letters (L-CSS)
- 4 paper in IEEE Transactions on Control Systems Technology (TCST)
- 1 paper in Automatica
- 1 paper in International Journal of Robust and Nonlinear Control (RNC)
- 1 paper in SIAM Journal on Control and Optimization (SICON)
- 1 paper in Results in Control and Optimization (RICO)

Conference Papers

- 12 papers in IEEE Conference on Decision and Control (CDC)
- 9 papers in American Controls Conference (ACC)
- 1 paper in IEEE Conference on Control Technology and Applications (CCTA)

Technical Skills

Software: Python, MATLAB, C/C++, Java, LaTeX, Metapost, TikZ, R, HTML, ROS
Version Control Tools: Github, Bitbucket
Libraries and Toolboxes: CVX, Simulink, SLS Toolbox