SooJean Han

Assistant Professor, Director of Autonomous Control for Stochastic Systems (ACSS)
School of Electrical Engineering, Korea Advanced Institute of Science & Technology (KAIST)
soojean(at)kaist.ac.kr | linkedin.com/in/soojean-han | soojean.github.io

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**, 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
  - **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)*, Mar 2024. Under review
  - Mukul Chodhary, Kevin Octavian, and **SooJean Han**. Efficient Replay Memory Architectures in Multi-Agent Reinforcement Learning for Network Congestion Control. In *Proceedings of the 41st International Conference on Machine Learning*, ICML, 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]

Lecture Materials and Manuscripts

- SooJean Han. Results from Renewal Theory and Its Applications. 2022
- SooJean Han. Stochastic Processes for Control Engineers. 2016-
- SooJean Han. Efficient Redundancy-Free Computation in Large-Scale Problems via Quantum Implementation of Machine Learning Approaches. 2022
- SooJean Han. Application of Girsanov's Theorem for Brownian Motion and Poisson Processes to Common Filtering Methods in Engineering. 2021
- SooJean Han. Methods of Filtering for Single and Multi-Sensor Data Fusion. 2019-2021
- SooJean Han. Notes on the Comparison Lemma and Various Forms of Gronwall's Inequality. 2021
- SooJean Han. Notes on Weak Convergence and the Skorokhod Topology. 2020

Education

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

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

Work & Internship Experience

Assistant Professor at KAIST Aug 2023
Tenure-track assistant professor in the School of Electrical Engineering at KAIST. 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. Currently, we have 5 graduate students, 2 research interns, and 6 undergraduate students.

Postdoctoral Scholar Feb 2023 - Aug 2023
Worked on the development of perception-based motion-planning algorithms based on diffusion machine learning models for autonomous drones at the Autonomous Robotics and Control Lab (ARCL). Supported by the DARPA Learning in Control (LINC) initiative and the ONR.

Summer Internship at JPL (DARPA SubT) Jun 2018 - Aug 2018
Involved with the DARPA Subterranean (SubT) Challenge under the supervision of Dr. Ali Agha as a part of Team CoSTAR. Implemented ORBSLAM using C/C++ and deployed it on terrestrial drones to perform distributed collaborative mapping and merging using keypoint feature detection.

Research Assistant at Caltech CAST Jun 2017 - Aug 2017
Used ROS and the VICON motion capturing system for distributed control over multiple Crazyflie quadrotors for synchronization and formation-flying in ARCL. PID and nonlinear controllers were implemented in Python and C++.

Undergraduate Research Assistant at UC Berkeley BAIR Jan 2017 - May 2017
Developed and implemented obstacle detection on MATLAB for the FaSTrack algorithm in Professor Claire Tomlin's Hybrid Systems Lab. Relevant publications are [here] and [here].

Teaching & Mentoring Experience

EE488F: Learning Patterns for Autonomous Control Aug 2023 - Dec 2023
Created and taught advanced topics course at KAIST during Fall 2023. The theme is to identify and use patterns in intelligent autonomous systems. By studying patterns, many control and state-estimation algorithms can be more efficient in data consumption and computation time. Relevant motivating applications include robotic path-planning with AI, fault-tolerant control, and decision-making networks (e.g., vehicle traffic systems, UAV traffic management).

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'd for CDS 112/Ae103a taught by Professor Soon-Jo Chung 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.

Invited Seminars and Symposiums

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].

Fellowships

NSF GRFP Jun. 2019 - Jun. 2022
Caltech Special EAS Fellowship Jun. 2017 - Jun. 2019

Peer Review Experience

Journal Articles
- 4 papers in IEEE Transactions on Automatic Control (TAC)
- 6 papers in IEEE Control Systems Letters (L-CSS)
- 2 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
- 8 papers in IEEE Conference on Decision and Control (CDC)
- 4 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