Kristen Such

https://suchkristenwow.github.io/

Education

University of Colorado Boulder *Aug 2019 - Dec 2024*

PhD of Robotics

- **Research Theme**: Long-Term data association for agricultural applications
- **Advisor**: Christoffer Heckman

M.S of Mechanical Engineering

University of Chicago *Sep 2015 - June 2019*

B.S of Computational and Applied Math

- **Honors**: Dean's list, UAA All American, College Research Fellowship

Experience

University of Colorado Boulder 5 + Years Research Experience

Graduate Research Assistant - Autonomous Robotics and Perception Group *May 2020 - March 2025*

- **RestoreBot [2]**
  - Led development and field testing of an autonomous ground robot for precision seeding in degraded rangelands, integrating navigation, vision, and control in complex, unstructured environments.
  - Engineered a modular autonomy stack incorporating real-time localization and fault-tolerant behaviors for mission success under harsh field conditions.
  - Developed vision-based navigation and contact-aware microsite detection using deep learning and semantic segmentation to support adaptive robotic manipulation in natural environments.
- **BetterFaster SLAM**
  - Designed and implemented a Bayesian feature association and localization framework enabling long-term, robust place recognition with time-varying observations (e.g., seasonal vegetation changes).
  - Validated the approach in urban environments using CARLA, an Unreal Engine-based high-fidelity self-driving car simulator, in addition to a low-fidelity 2D simulation with a noisy sensor model resulting in a 56% reduction in mean squared error in the landmark position estimation as well as increased robustness to incorrect data association.
- **Foundation Model-Driven Robotic Exploration [1]**
  - Leveraged large language models (LLMs) to enhance robotic exploration in unmapped office, domestic, and industrial environments. Integrated visual question-answering for scene understanding and semantic parsing.
  - Implemented testing of this method in a photorealistic custom simulation environment based on Unreal Engine. Results indicated an overall improvement in exploration tasks in unmapped environments based on semantic and temporal cues, failsafing against complete failure in it's entirety over volumetric-gain based exploration.
  - Extended prior work [1] to ecological intervention tasks, developed detection and navigation methods for out-of-distribution objects, integrated human-in-the-loop feedback, and multi-modal fault tolerance.
- **Heterogeneous Multi-Robot Collaboration [3]**
  - Conducted decentralized multi-robot SLAM and object tracking experiments using two Clearpath Husky robots using different SLAM methods (lidar-inertial and stereo-inertial).
  - Demonstrated effective collaboration between heterogeneous estimation algorithms, leveraging factor graphs for efficient data sharing and scalability.

Graduate Research Assistant - Animal Inspired Movement and Robotics Laboratory *Jan 2020 - May 2020*

- Experimented on wolf spiders with the motivation of characterizing locomotion under different gravitational

loads using high-speed videography. Performed analysis of spider video data using DeepLabCut. Advised by Kaushik Jayaram.

Graduate Research Assistant - Soft Matter Mechanics Group *Aug 2019 - Dec 2019*

- Studied and developed models of active matter dynamic networks for the sake of deducing fundamental laws of swarming networks such as those observed in fire-ant aggregations or clusters of cells. Advised by Franck Vernerey. [4]

Illinois Institute of Technology

Undergraduate Research Assistant *Dec 2017 - May 2019*

- **JAMoEBA**: Prototyped modular subunits for a boundary-constrained soft robotic system which can manipulate external objects in 2 dimensions or navigate through narrow corridors using vacuum jamming. The project was in collaboration with Matthew Spenko (IIT) and Heinrich Jaeger (U. Chicago) in response to the NSF C3 SoRo grant solicitation (Continuum, Compliant, and Configurable Soft Robotics Engineering).

IBM

Summer Research Intern - Nanoscale Fabrication Group *June 2018 - Aug 2018*

- **Electronic Nose**: Altered and improved on previous sensor interfaces to allow for modularity of gas sensors on an Electronic Nose project. The Electronic Nose was an exploratory research project which was aimed at training an AI model to create unique fingerprints for odors for identification in industrial regulation and medical applications.

Publications

[1] H. Biggie, P. Cooper, D. Albin, K. Such, and C. Heckman, "Cogexplore: Contextual exploration with language-encoded environment representations," *arXiv*, 2024. arXiv: 2406.17180 [cs.RO]. [Online]. Available: https://arxiv.org/abs/2406.17180.

[2] K. Such, H. Biggie, and C. Heckman, "Restorebot: Towards an autonomous robotics platform for degraded rangeland restoration," in *Experimental Robotics - The 18th International Symposium, ISER 2023, Melia, Chiang Mai, Thailand, 26-30 November 2023*, M. H. A. Jr. and O. Khatib, Eds., ser. Springer Proceedings in Advanced Robotics, vol. 30, Springer, 2023, pp. 319–331. DOI: 10.1007/978-3-031-63596-0_28. [Online]. Available: https://doi.org/10.1007/978-3-031-63596-0_28.

[3] O. Dagan, T. Cinquini, L. Morrissey, K. Such, N. Ahmed, and C. Heckman, "Towards decentralized heterogeneous multi-robot slam and target tracking," A. Davison and J. Ortiz, Eds., [Online]. Available: https://openreview.net/forum?id=Emr1YI5FNFO.

[4] R. Wagner, K. Such, E. Hobbs, and F. Vernerey, "Treadmilling and dynamic protrusions in fire ant rafts," *Journal of the Royal Society Interface*, vol. 18, no. 179, p. 20 210 213, 2021. DOI: 10.1098/rsif.2021.0213. [Online]. Available: https://royalsocietypublishing.org/doi/10.1098/rsif.2021.0213.

Teaching Experience

Teaching Assistant: System Dynamics *Spring 2020*

- Covers linear dynamic systems and mathematical tools for understanding them. Topics include Laplace transform, multi-domain system modeling, input-output relationships, time-domain response, Fourier series, frequency-domain response, and introduction to feedback control.

Teaching Assistant: Data Analysis and Experimental Methods *Fall 2020, Spring 2021*

- Learn to plan and carry out experiments and analyze the results. Topics covered include measurement fundamentals, design of experiments, elementary statistics and uncertainty analysis. Topics in statistics include probability, error propagation, confidence intervals, hypothesis testing, linear regression, one- and two-factor ANOVA and time series analysis.

Skills

Programming: Python, C++, MATLAB, Git, ROS, Docker

Mathematical Expertise: Bayesian filtering, MDPs, convex optimization, numerical solvers.

Hardware Integration: Multi-modal sensor fusion, embedded system debugging, extensive (3+ years) field deployment experience.