Preston Culbertson

Curriculum Vitae

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Education

Stanford University
PhD in Mechanical Engineering *2022*
Advisor: Mac Schwager

Stanford University
MS in Mechanical Engineering *2020*

Georgia Institute of Technology
BS in Mechanical Engineering *2016*

Work Experience

California Institute of Technology
Postdoctoral Scholar *2022 - present*
Advisor: Aaron Ames

Caltech / NASA Jet Propulsion Laboratory
NSTRF Visiting Technologist *2018 - 2021*

Caltech / NASA Jet Propulsion Laboratory
Graduate Student Intern *2017*

Research Summary

I am interested in building **collaborative** robots that can **understand and interact** with their environment, humans, and other robots. My primary research interests are **adaptive** and **learning-based control**, **manipulation and grasping**, and **multi-agent interaction and coordination** (especially without communication). My existing research threads are best summarized as:

- Decentralized, adaptive control for collaborative manipulation of unknown objects,
- Integrating learning-based perception methods into robot motion planning, and
- Fast, efficient discrete optimization for assembly, grasp, and motion planning.

Awards

RSS Pioneer, Workshop for top early-career robotics researchers. *Robotics: Science and Systems Pioneers Workshop*, 2021.

ICRA Best Manipulation Paper Award, "Decentralized adaptive control for collaborative manipulation." *ICRA 2018*.

ICRA Best Multi-Robot Systems Paper Finalist, "Decentralized adaptive control for collaborative manipulation." *ICRA 2018*.

NASA Space Technology Research Fellowship, Awarded to 56 students in the US. *National Aeronautics and Space Administration*, 2018.

NSF GRFP Honorable Mention, *National Science Foundation Graudate Research Fellowship Program*, 2018.

Graduate School of Engineering Fellowship, *Stanford University*, 2016.

Richard K. Whitehead Jr. Memorial Award, Awarded to the top three graduating seniors in Mechanical Engineering. *Georgia Institute of Technology*, 2016.

President's Scholarship, "Full ride" merit scholarship awarded to top 50 incoming undergraduates, *Georgia Institute of Technology*, 2012.

Teaching Experience

Graduate Teaching Assistant
AA273: State Estimation and Filtering for Aerospace Systems — *Spring 2022*

Graduate Teaching Assistant
AA273: State Estimation and Filtering for Aerospace Systems — *Spring 2021*

Graduate Teaching Assistant
AA273: State Estimation and Filtering for Aerospace Systems — *Spring 2018*

Graduate Teaching Assistant
AA277: Multi-Robot Control, Communication, and Sensing — *Winter 2018*

Academic Publications and Presentations

* *indicates equal contribution*

Journal Articles

1. T. Chen, **P. Culbertson**, and M. Schwager, "CATNIPS: Collision avoidance through neural implicit probabilistic scenes," in *IEEE Transactions on Robotics (T-RO)*, 2023. ***Under Review.***

2. M. Adamkiewicz*, T. Chen*, A. Caccavale, R. Gardner, **P. Culbertson**, J. Bohg, and M. Schwager, "Vision-only robot navigation in a neural radiance world," in *IEEE Robotics and Automation Letters (RA-L),* 2021.

3. A. Cauligi, **P. Culbertson**, E. Schmerling, M. Schwager, B. Stellato, M. Pavone, "CoCo: Online mixed-integer control via supervised learning," in *IEEE Robotics and Automation Letters (RA-L),* 2021.

4. **P. Culbertson**, J.-J. Slotine, M. Schwager, "Decentralized adaptive control for collaborative manipulation of rigid bodies," in *IEEE Transactions on Robotics (T-RO),* 2021.

Conference Papers

1. A. H. Li, **P. Culbertson**, J. W. Burdick, and A. D. Ames, "FRoGGeR: Fast robust grasp generation via the min-weight metric," in *IEEE/RSJ International Conference on Intelligent Robots and Systems,* 2023. ***Under Review.***

2. R. K. Cosner, **P. Culbertson**, A. J. Taylor, and A. D. Ames, "Robust safety under stochastic uncertainty with discrete-time control barrier functions," in *Robotics: Science and Systems (RSS),* 2023. ***Under Review.***

3. **P. Culbertson**, S. Bandyopadhyay, A. Goel, P. McGarey, and M. Schwager, "Multi-robot assembly scheduling for the Lunar Crater Radio Telescope on the far-side of the moon," in *IEEE Aerospace Conference,* 2022.

4. C. Chen, **P. Culbertson**, M. Lepert, M. Schwager, and J. Bohg, "TrajectoTree: Trajectory optimization meets tree search for planning multi-contact dexterous manipulation," in *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS),* 2021.

5. A. Cauligi*, **P. Culbertson***, B. Stellato, D. Bertsimas, M. Schwager, and M. Pavone, "Learning mixed-integer convex optimization strategies for robot planning and control," in *Conference on Decision and Control (CDC),* 2020.

6. **P. Culbertson,** S. Bandyopadhyay, and M. Schwager, "Multi-robot assembly sequencing via discrete optimization," in *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS),* 2019.

7. **P. Culbertson** and M. Schwager, "Decentralized adaptive control for collaborative manipulation," in *IEEE International Conference on Robotics and Automation (ICRA),* 2018. **Best Manipulation Paper Award.**

8. P. Slade, **P. Culbertson**, Z. Sunberg, M. Kochenderfer, "Simultaneous active parameter estimation and control using sampling-based Bayesian reinforcement learning," in *IEEE/RSJ International Conference on Intelligent Robotics and Systems (IROS),* 2017.

Workshops and Invited Presentations

1. Stanford Machine Learning and Statistics Lunch (Seminar), *Collaborative Manipulation in the Wild*, 2022.

2. Ames-Burdick Group Meeting, Caltech (Seminar), *Collaborative Manipulation in the Wild*, 2021.

3. ASE 389: Modeling Multi-Agent Systems, UT Austin (Guest Lecture), *Decentralized Adaptive Control for Collaborative Manipulation*, 2021.

4. NASA Technology Integration Meeting on Lunar Excavation and Construction, *Collaborative Manipulation for Space Exploration and Construction*, 2021.

5. Learning Meets Combinatorial Algorithms Workshop, Conference on Neural Information Processing Systems (NeurIPS), *CoCo: Learning Mixed-Integer Convex Optimization Strategies for Robot Planning and Control*, 2020.

6. Bay Area Machine Learning Symposium, *Learning Mixed-Integer Convex Optimization Strategies for Robot Planning and Control*, 2020.

7. AA277: Multi-Robot Control, Communication and Sensing (Guest Lecture), *Decentralized Adaptive Control for Collaborative Manipulation*, 2019.

8. Conference on Learning for Dynamics and Control (L4DC), *Decentralized Adaptive Control of Hamiltonian Systems*, 2019.

9. Bay Area Robotics Symposium (BARS), *Decentralized Adaptive Control for Collaborative Manipulation*, 2017.

Professional Activities

Professional Service

1. Co-organizer, Workshop on Motion Planning with Implicit Neural Representations of Geometry, International Conference on Robotics and Automation (ICRA), 2022.

2. Faculty Committee, RSS Pioneers Workshop, Robotics: Science and Systems, 2022.

3. Program Committee, Robot Learning Workshop: Self-Supervised and Lifelong Learning, Conference on Neural Information Processing Systems (NeurIPS), 2021.

Review Activities

1. American Control Conference

2. IEEE International Conference on Robotics and Automation (ICRA)

3. IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)

4. IEEE International Conference on Systems, Man, and Cybernetics (SMC)

5. Field Robotics

6. IEEE Robotics and Automation Letters (R-AL)

7. IEEE Robotics and Autonomous Systems
8. IEEE Transactions on Artificial Intelligence (T-AI)
9. IEEE Transactions on Automatic Control (T-AC)
10. IEEE Transactions on Robotics (T-RO)

Mentorship Activities

1. Graduate Research Mentor, Multi-Robot Systems Lab, 2018-2022.
2. After-School Tutor, S.A.Y. Yes! Center, 2015-2016.
3. Programming Workshop Leader, Vine City Code Crew, 2015-2016.