

# Preston Culbertson

## Curriculum Vitae

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## Education

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### 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

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### 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

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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

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**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 Graduate 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

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### 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

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\* 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

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### *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.