Abhishek Cauligi
Robotics Technologist – NASA Jet Propulsion Lab

Education

Ph.D. Aeronautics & Astronautics, Stanford University, 2021.
Advisor: Marco Pavone
NASA Space Technology Research Fellow

M.S. Aeronautics & Astronautics, Stanford University, 2018.

B.S. Aerospace Engineering, University of Michigan – Ann Arbor, 2016.
Advisor: Brian Gilchrist

Research Interests

My research interests span the problems of planning and control for complex spacecraft robotic systems. I am particularly interested in leveraging recent advances in nonlinear optimization, machine learning, and control theory towards:

1. Enabling safe planning and decision-making for robotic systems.

2. Infusing data-driven approaches into robot optimal control and reinforcement learning.

3. Advancing the state-of-the-art in spacecraft robotic system development.

Professional Experience

NASA Jet Propulsion Lab – Robotic Surface Mobility Group. Robotics Technologist, March 2022 – present.

Mitsubishi Electric Research Labs – Control & Autonomy Group. Research Intern, June – Sep. 2021.
Mentor: Rien Quirynen, *Boston, MA*

NASA Jet Propulsion Lab – Robotic Aerial Mobility Group. NSTRF Visiting Technologist, June – Sep. 2019.
Mentor: Ali Agha, *Pasadena, CA*

NASA Ames Research Center – Intelligent Robotics Group. NSTRF Visiting Technologist, Summers 2017 & 2018.
Mentors: Brian Coltin & Trey Smith, *Sunnyvale, CA*

SpaceX – GNC Mission Design Group. Guidance, Navigation, & Controls Intern, May – Aug. 2016.
Mentor: John Stedl, *Hawthorne, CA*

Planetary Resources. Attitude Dynamics & Controls Intern, Jan. – July 2015.
Mentors: Brian Douglas & Hannah Goldberg, *Redmond, WA*

Honors and Awards

IEEE Robotics and Automation Magazine Best Paper Award, 2023.

NASA Space Technology Research Fellowship, 2016 – 2020.

NSF Graduate Research Fellowship Honorable Mention, 2016.

Univ. of Michigan College of Engineering's Scholarship of Honor (largest offered merit scholarship), 2012 – 2016.

The Boeing Company Endowed Scholarship, 2013 – 2014.

Univ. of Michigan William J. Branstrom Freshman Prize (top 5% of class), 2012 – 2013.

Academic Publications & Presentations

Under Review

[U1]   J. Briden, C. Choi, K. S. Yun, R. Linares, and **A. Cauligi**. "Constraint-Informed Learning for Warm Starting Trajectory Optimization". In: *AIAA Journal of Guidance, Control, and Dynamics* (2024).

[U2]   J. Briden, T. Gurga, B. Johnson, **A. Cauligi**, and R. Linares. "Transformer-based Tight Constraint Prediction for Efficient Powered Descent Guidance". In: *AIAA Journal of Guidance, Control, and Dynamics* (2024).

[U3]   K. Echigo, **A. Cauligi**, S. Bandyopadhyay, D. Scharf, G. Lantoine, B. Açıkmeşe, and I. Nesnas. "HARP: Hierarchical Asteroid Reconnaissance Planner via Stochastic Optimization". In: *AIAA Journal of Guidance, Control, and Dynamics* (2024).

[U0]   T.-I. Szatmari and **A. Cauligi**. "Federated Multi-Agent Mapping for Planetary Exploration". In: *Int. Symp. on Artificial Intelligence, Robotics and Automation in Space*. 2024.

Journal Articles

[J1]   D. Atha, M. R. Swan, **A. Cauligi**, A. Bettens, E. Goh, and M. Ono. "ShadowNavV2: Lunar Absolute Localization in Darkness using Craters as Landmarks". In: *IEEE Transactions on Field Robotics* (2024).

[J2]   **A. Cauligi**, P. Culbertson, E. Schmerling, M. Schwager, B. Stellato, and M. Pavone. "CoCo: Online Mixed-Integer Control via Supervised Learning". In: *IEEE Robotics and Automation Letters* 7.2 (2022), pp. 1447–1454.

[J3]   T. G. Chen*, **A. Cauligi***, S. A. Suresh, M. Pavone, and M. R. Cutkosky. "Testing Gecko-Inspired Adhesives with Astrobee Aboard the ISS". In: *IEEE Robotics and Automation Magazine* 29.3 (2022), pp. 24–33. **Winner of IEEE RAM Best Paper Award for 2023**.

Conference Papers

[C1]   R. Brockers, **A. Cauligi**, K. Albee, R. Hewitt, J. Delaune, P. Proença, and J.-P. de la Croix. "How to Drive on the Moon with a Miniature Rover: CADRE Surface Mobility". In: *IEEE Aerospace Conference*. 2025.

[C2]   K. Echigo, **A. Cauligi**, S. Bandyopadhyay, D. Scharf, G. Lantoine, B. Açıkmeşe, and I. Nesnas. "Autonomy in the Real-World: Autonomous Trajectory Planning for Asteroid Reconnaissance via Stochastic Optimization". In: *AIAA Scitech Forum*. 2025.

[C3]   J. Briden, T. Gurga, B. Johnson, **A. Cauligi**, and R. Linares. "Improving Computational Efficiency for Powered Descent Guidance via Transformer-based Tight Constraint Prediction". In: *AIAA Scitech Forum*. 2024. **Winner of 2024 AIAA GNC Graduate Student Paper Competition**.

[C4]   J.-P. de la Croix, F. Rossi, R. Brockers, D. Aguilar, K. Albee, E. Boroson, **A. Cauligi**, J. Delaune, et al. "Multi-Agent Autonomy for Space Exploration on the CADRE Lunar Technology Demonstration Mission". In: *IEEE Aerospace Conference*. 2024.

[C5]   K. Echigo, **A. Cauligi**, and B. Açıkmeşe. "Expected Time-Optimal Control: a Particle MPC-based Approach via Sequential Convex Programming". In: *Proc. IEEE Conf. on Decision and Control*. 2024.

[C7]   **A. Cauligi**[*], M. R. Swan[*], M. Ono, S. Daftry, J. Elliott, L. Matthies, and D. Atha. "ShadowNav: Crater-Based Localization for Nighttime and Permanently Shadowed Region Lunar Navigation". In: *IEEE Aerospace Conference*. 2023.

[C8]   **A. Cauligi**, A. Chakrabarty, S. Di Cairano, and R. Quirynen. "PRISM: Recurrent Neural Networks and Presolve Methods for Fast Mixed-integer Optimal Control". In: *Learning for Dynamics & Control*. 2022.

[C9]   **A. Cauligi**[*], T. Chen[*], S. A. Suresh, M. Dille, R. G. Ruiz, A. M. Vargas, M. Pavone, and M. R. Cutkosky. "Design and Development of a Gecko-Adhesive Gripper for the Astrobee Free-Flying Robot". In: *Int. Symp. on Artificial Intelligence, Robotics and Automation in Space*. 2020.

[C10] **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: *Proc. IEEE Conf. on Decision and Control*. 2020.

[C11] R. Bonalli, A. Bylard, **A. Cauligi**, T. Lew, and M. Pavone. "Trajectory Optimization on Manifolds: A Theoretically-Guaranteed Embedded Sequential Convex Programming Approach". In: *Robotics: Science and Systems*. 2019.

[C12] R. Bonalli, **A. Cauligi**, A. Bylard, and M. Pavone. "GuSTO: Guaranteed Sequential Trajectory Optimization via Sequential Convex Programming". In: *Proc. IEEE Conf. on Robotics and Automation*. 2019.

Workshop Papers

[W1]   **A. Cauligi**, P. Culbertson, M. Schwager, B. Stellato, and M. Pavone. "CoCo: Learning Strategies for Online Mixed-Integer Control". In: *Conf. on Neural Information Processing Systems - Learning Meets Combinatorial Algorithms Workshop*. 2022.

[W2]   **A. Cauligi**, A. Bylard, R. Bonalli, and M. Pavone. "A Sequential Convex Programming Approach for Free-Flying Robot Trajectory Generation". In: *Int. Symp. on Artificial Intelligence, Robotics and Automation in Space*. 2018.

Invited Talks & Posters

[I1]   *Enabling Long-Range Autonomy for Future Spacecraft Missions*. At USC-MHI Cyber-Physical Systems Seminar. Oct. 2022.

[I2]   *Gecko-Inspired Perching Gripper for the Astrobee Free-Flying Robot*. At NASA Space Technology Mission Directorate (STMD) Program Review. May 2021.

[I3]   *CoCo: Learning Strategies for Online Mixed-Integer Control*. At Bay Area Machine Learning Symposium. Oct. 2020.

[I4]   *Safe Learning for Spacecraft Trajectory Optimization and Control*. At Robotic Technology for In-Space Assembly Workshop (ICRA), Montreal, Canada. May 2019.

[I5]   *Trajectory Optimization for Free-Flying Robots: Sequential Convex Programming-Based Approach*. At NASA Tech Day on the Hill, Washington, D.C. Dec. 2019.

[I6]   *GuSTO: Guaranteed Sequential Trajectory Optimization via Sequential Convex Programming*. At NASA Space Technology Mission Directorate (STMD) Autonomy Workshop, Pittsburgh, PA. Oct. 2018.

Accepted JPL Proposals

[P1] **A. Cauligi**, K. Albee, C. Choi, and J.-P. de la Croix. "Learning-Based Amortized Optimization for Accelerating Robot Motion Planning". In: *JPL Data Science Pilot Proposal*. 2023. Total award: $50,000.

[P2] **A. Cauligi** and G. Befekadu. "Accelerating Optimization-Based Motion Planners for Surface Rover Platforms". In: *Center for Academic Partnerships (CAP)*. 2023. Total award: $4,000.

[P3] **A. Cauligi** and A. Anandkumar. "Bridging the Gap Between Model-Based Reinforcement Learning and Amortized Optimization". In: *JPL Researchers on Campus (JROC)*. 2022. Total award: $25,000.

[P4] C. Choi, **A. Cauligi**, and K. Yun. "Task-Relevant Machine Learning for Fast Rover Model Predictive Control". In: *Spontaneous R&TD Proposal*. 2022. Total award: $40,000.

Technical Skills

Software: Python, C++, Julia, ROS, Linux, Git/SVN, Matlab/Simulink, amateur radio (`KG7QQN`).

Coursework: Convex Optimization, Optimal Control, Machine Learning, Reinforcement Learning, Autonomous Robotics.

Teaching

Teaching Assistant, AA 274B: Principles of Robot Autonomy II (Stanford), Winter 2021.

Teaching Assistant, AA 274A: Principles of Robot Autonomy I (Stanford), Autumn 2020.

Instructor, AI4ALL/SAILORS Robotics Camp (Stanford), Summer 2018.

Academic Service

PhD. Committees

Julia Briden, MIT Aero/Astro (advised by Prof. Richard Linares)   2022–2024

Reviewing

IEEE Conference on Decision & Control (CDC)

International Journal of Robotics Research (IJRR)

IEEE International Conference on Intelligent Robots and Systems (IROS)

International Symposium on Robotics Research (ISRR)

IEEE Transactions on Robotics (T-RO)

IEEE Robotics and Automation Letters (RA-L)

Distributed Autonomous Robotic Systems (DARS)

Press Coverage

1. Jennifer Kite-Powell, This Gecko-Inspired Robotic Gripper Could Help Clean Up Space Junk. Forbes. May 20, 2021.

2. Allison Gasparini, Stanford 'gecko gripper' tested on the International Space Station. Stanford News. May 20, 2021.

3. Gianine Figliozzi, Sticking Around: Astrobee tests gecko-inspired adhesives in space. NASA Ames newsletter. May 18, 2021.

4. Ingrid Fadelli, A gecko-adhesive gripper for the Astrobee free-flying robot. Tech Xplore. Oct. 20, 2020.