

Ryan Kazuo Cosner

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RESEARCH INTERESTS

*I study risk-sensitive, nonlinear control in the context of safety-critical systems with the goal of developing and deploying provably safe and performant robots. I am particularly interested in leveraging theoretical methods in conjunction with machine learning tools to produce robots which are capable of adroitly navigating the complexities of the real world. My research can be broadly categorized as: **guaranteeing safe and performant feedback control of uncertain systems.***

EDUCATION

California Institute of Technology

PhD, Mechanical Engineering

MS, Mechanical Engineering: Robotics, Controls, and Dynamics Emphasis

University of California, Berkeley

BS, Mechanical Engineering

Pasadena, CA

Sep. 2019 – June 2024

Sep. 2019 – June 2021

Berkeley, CA

Aug. 2015 – May 2019

RESEARCH

AMBER Lab - Prof. Aaron D. Ames

June 2020 – Present

- Committee members: Aaron D. Ames, Joel Burdick, Katherine L. Bouman, Yisong Yue
- Developed theory for controllers which guarantee safety in the context of bounded state uncertainty, dynamics modeling error, and external disturbances
- Developed theory for controllers with risk-sensitive safety guarantees in the presence of unbounded uncertainties
- Deployed safety methods on custom wheeled, quadrupedal, bipedal, and flying robots.

NVIDIA Research - Professor Marco Pavone

June 2022 – September 2022

- Developed a method for learning responsibility allocations for autonomous vehicles

BEST Lab - Professor Alice Agogino

May 2017 – May 2019

- Developed motor system for 6-bar tensegrity robot
- Performed drop tests and analysed impact data

CalWave Power Technologies - Professor Reza Alam

May 2018 – May 2020

- Developed adjustable mooring system for renewable wave energy converter
- Performed experimental study on the effects of surface perforations on energy absorption

PUBLICATIONS

1. *Generative Modeling of Residuals for Real-Time Risk-Sensitive Safety with Discrete-Time Control Barrier Functions* ([pdf](#))
Ryan K. Cosner, Igor Sadalski, Jana K. Woo, Preston Culbertson, Aaron D. Ames.
Submitted to the International Conference on Robotics and Automation (ICRA), 2024.
2. *Safe Dynamics Learning with Initially Infeasible Safety Certificates* ([pdf](#))
Alexandre Capone, **Ryan K. Cosner**, Aaron D. Ames, Sandra Hirche.
Submitted to the American Controls Conference (ACC), 2024.
3. *Input-to-State Stability in Probability* ([pdf](#))
Preston Culbertson, **Ryan K. Cosner**, Maegan Tucker, Aaron D. Ames.
Conference on Decision and Control (CDC), 2024.
4. *Robust Safety under Stochastic Uncertainty with Discrete-Time Control Barrier Functions* ([pdf](#))
Ryan K. Cosner, Preston Culbertson, Andrew J. Taylor, Aaron D. Ames.
Robotics: Science and Systems (RSS), 2023.

5. *Learning Responsibility Allocations for Safe Human-Robot Interaction with Applications to Autonomous Driving* ([pdf](#))
Ryan K. Cosner, Yuxiao Chen, Karen Leung, Marco Pavone.
 International Conference on Robotics and Automation (ICRA), 2023.
6. *Receding Horizon Planning with Rule Hierarchies for Autonomous Vehicles* ([pdf](#))
 Shushant Veer, Karen Leung, **Ryan K. Cosner**, Yuxiao Chen, Marco Pavone.
 International Conference on Robotics and Automation (ICRA), 2023.
7. *End-to-End Imitation Learning with Safety Guarantees using Control Barrier Functions* ([pdf](#))
Ryan K. Cosner, Yisong Yue, Aaron D. Ames.
 Conference on Decision and Control (CDC), 2022.
8. *Safety of Sampled-Data Systems with Control Barrier Functions via Approximate Discrete Time Models.* ([pdf](#))
 Andrew J. Taylor*, Victor D. Dorobantu*, **Ryan K. Cosner***, Yisong Yue, Aaron D. Ames.
 Conference on Decision and Control (CDC), 2022.
9. *Safety-Aware Preference-Based Learning for Safety-Critical Control.* ([pdf](#))
Ryan K. Cosner, Maegan Tucker, Andrew J. Taylor, Kejun Li, Tamas G. Molnar, Anil Alan, Gabor Orosz, Yisong Yue, Aaron D. Ames.
 Learning for Dynamics and Control Conference (L4DC), 2022.
10. *Self-Supervised Online Learning for Safety-Critical Control using Stereo Vision.*
Ryan K. Cosner*, Ivan D. Jimenez Rodriguez*, Tamas G. Molnar, Wyatt Ubellacker, Yisong Yue, Aaron D. Ames, Katherine L. Bouman.
 International Conference on Robotics and Automation (ICRA), 2022.
11. *A Constructive Method for Designing Safe Multirate Control for Differentially-Flat Systems.*
 Devansh R. Agrawal*, Hardik Parwana*, **Ryan K Cosner***, Ugo Rosolia, Aaron D. Ames, Dimitra Panagou.
 IEEE Control Systems Letters (CSL), 2021.
12. *Model-Free Safety-Critical Control for Robotic Systems.* ([pdf](#))
 Tamas G. Molnar, **Ryan K. Cosner**, Andrew W. Singletary, Wyatt Ubellacker, Aaron D. Ames.
 IEEE Robotics and Automation Letters (RAL), 2021.
13. *Measurement-Robust Control Barrier Functions: Certainty in Safety with Uncertainty in State.* ([pdf](#))
Ryan K. Cosner, Andrew W. Singletary, Andrew J. Taylor, Tamas G. Molnar, Aaron D. Ames.
 International Conference on Intelligent Robots and Systems (IROS), 2021.
14. *Multi-rate Control Design under Input Constraints via Fixed-Time Barrier Functions.* ([pdf](#))
 Kunal Garg, **Ryan K. Cosner**, Ugo Rosolia, Aaron D. Ames, Dimitra Panagou.
 IEEE Control Systems Letters (CSL), 2021.
15. *Episodic Learning for Safe Bipedal Locomotion with Control Barrier Functions and Projection-to-State Safety.* ([pdf](#))
 Noel Csomay-Shanklin*, **Ryan K. Cosner***, Min Dai*, Andrew J. Taylor, Aaron D. Ames.
 Learning for Dynamics and Control Conference (L4DC), 2021.
16. *Guaranteeing Safety of Learned Perception Modules via Measurement-Robust Control Barrier Functions.* ([pdf](#))
 Sarah Dean, Andrew J. Taylor, **Ryan K. Cosner**, Benjamin Recht, and Aaron D. Ames.
 Conference on Robotic Learning (CoRL), 2020.
 Best Student Paper Finalist.

INTERNSHIPS

Nvidia Corporation, Research Intern	Summer 2022
<ul style="list-style-type: none">Performed research on responsibility allocations and safety with rule hierarchies for autonomous vehicles under the direction of Prof. Marco Pavone (Stanford University), Prof. Karen Leung (University of Washington), Yuxiao Chen, and Shushant Veer.	
Squishy Robotics, Mechatronics Intern	Summer 2019
<ul style="list-style-type: none">Redesigned the robots main electronics capsule and PCBAdded hardware and software for high-speed collection of impact acceleration data	
Ford Motor Company, Electrical Testing and Autonomous Vehicle Intern	Summer 2018
<ul style="list-style-type: none">Restructured vehicle cold-start test to combine multiple tests into one streamlined procedureOptimized code for processing of autonomous vehicle data to reduce computation time	
LA Biomed, Summer Fellow	Summer 2015
<ul style="list-style-type: none">Developed a method to test for MPS II without the use of radioactive material	
The Boeing Company, Summer Intern	Summer 2014
<ul style="list-style-type: none">Designed a tactile tool for quick iterative design of satellitesAnalyzed the thermal properties of carbon-nanotube composites for use as radiative insulators	

SERVICE AND OUTREACH

Academic Peer Reviewer (22 papers)	September 2021 - Present
<ul style="list-style-type: none">Reviewed Submissions for (1) ACC 2022, (1) L4DC 2022, (2) CDC 2022, (1) MECC 2022, (1) NeuRips 2023, (4) L4DC 2023, (5) ICRA 2023, (2) CDC 2023, (1) TAC 2023, (1) Automatica 2023, (1) LCSS 2023, (2) RAL 2023	
Caltech Triathlon Leadership	September 2021 - Present
<ul style="list-style-type: none">President 2021-23. Organized 3 weekly workouts and 8 team races for Caltech and JPL students, staff, faculty, and community members.	
Science Olympiad: Test Writer & Event Supervisor	April 2023
<ul style="list-style-type: none">Wrote exam and supervised the High School-level "Detector Building" Event and supervised the "It's About Time" Event for the Southern California State-Level Science Olympiad competition.	
Caltech RISE, Volunteer Tutor	September 2019 - September 2021
<ul style="list-style-type: none">Tutored Pasadena Unified students struggling in math and science	
Southland Triathlon Series, Volunteer Founder and Race Coordinator	June 2020 - January 2021
<ul style="list-style-type: none">Organized a three free virtual races to keep people fit and connected despite social distancing	
UC Berkeley, Campus Tour Guide and Ambassador	January 2016 - May 2019
<ul style="list-style-type: none">Introduced prospective students to campus and helped them understand the application process	
United Technologies for Kids, Volunteer Teacher	January 2017-August 2017
<ul style="list-style-type: none">Developed and taught introductory design, electronics, and coding courses for middle and high school students	

TECHNICAL TOOLS

Languages: Python, C++, MATLAB, Julia, LabVIEW, Latex

Packages: Simulink, MATLAB Control Systems Toolbox, OpenCV (Python & C++), CVX, CVXPY, Numpy, Pandas, SciPy, Keras, Tensorflow, PyTorch

Software: Solidworks, Autodesk Fusion 360, Cura, Autodesk EAGLE, ROS, ROS2

AWARDS

Best Student Paper Finalist, <i>Conference on Robotic Learning</i>	2020
Graduate Student Fellowship, <i>Rose Hills Foundation</i>	2020
High Honors at Graduation, <i>UC Berkeley</i>	2019
Alexander and Ethel Levens Mechanical Engineering Award, <i>UC Berkeley</i>	2017
Regents' and Chancellor's Scholar, <i>UC Berkeley</i>	2015-2019
Chevron Academic Scholar, <i>Chevron, El Segundo</i>	2015
Eagle Scout, <i>BSA Troop 860, Hermosa Beach</i>	2014