Apurva Badithela

ab5832@princeton.edu
abadithela.github.io

Current Position

July 2024– Presidential Postdoctoral Research Fellow — Princeton University
Host: Anirudha Majumdar
Research focus: Efficient evaluation of robot foundation models leveraging tools from applied statistics, machine learning, formal methods, optimization and control theory, with applications in robot manipulation and navigation.

Education

2018–2024 PH.D. in Control and Dynamical Systems — California Institute of Technology
Thesis: Test and Evaluation of Autonomous Systems: Reactive Test Synthesis and Task-Relevant Evaluation of Perception [PDF]
Advisor: Richard M. Murray
Committee: Tichakorn Wongpiromsarn, Aaron D. Ames, Joel W. Burdick, Mani Chandy.

2014–2018 B.S. in Aerospace Engineering and Mechanics — University of Minnesota, Twin-Cities
Summa cum laude
Thesis: Exploiting Structure in Semidefinite Programming Problems with Applications to Robust Control
Advisor: Peter J. Seiler

Preprints[1]

2025 Lihan Zha, **Apurva Badithela**, Michael Zhang, Justin Lidard, Jeremy Bao, Emily Zhou, David Snyder, Allen Z Ren, Dhruv Shah, Anirudha Majumdar
Guiding Data Collection via Factored Scaling Curves
Under Review. [PDF]

2025 **Apurva Badithela**, Ranai Srivastav, Tichakorn Wongpiromsarn, and Richard M. Murray.
Task-Relevant Evaluation Metrics of Object Detection for Quantitative System-Level Analysis of Safety-Critical Autonomous Systems
Under Review. Submitted to ACM Transactions on Cyber-Physical Systems (T-CPS).

2025 Josefine B. Graebener*, **Apurva S. Badithela***, Denizalp Goktas, Wyatt Ubellacker, Eric V. Mazumdar, Aaron D. Ames, and Richard M. Murray.

[1] * denotes equal contribution.

Flow-Based Synthesis of Reactive Tests for Discrete Decision-Making Systems with Temporal Logic Specifications
Under Review. ArXiv abs/2404.09888. [PDF]

Peer-Reviewed Publications

2025 David Snyder, Asher J. Hancock, **Apurva Badithela**, Emma Dixon, Patrick Miller, Rares Andrei Ambrus, Anirudha Majumdar, Masha Itkina, and Haruki Nishimura
Is Your Imitation Learning Policy Better than Mine? Policy Comparison with Near-Optimal Stopping
Robotics: Science and Systems. [PDF]

2024 Inigo Incer, **Apurva Badithela**, Josefine Graebener, Piergiuseppe Mallozzi, Ayush Pandey, Sheng-Jung Yu, Albert Beneveniste, Benoit Caillud, Richard M. Murray, Alberto Sangiovanni-Vincentelli, and Sanjit Seshia.
Pacti: Scaling Assume-Guarantee Reasoning for System Analysis and Design
ACM Transactions on Cyber-Physical Systems (T-CPS), 2025, pp 1-35. [PDF][TOOL]

2023 **Apurva Badithela**, Tichakorn Wongpiromsarn, and Richard M. Murray.
Evaluation Metrics of Object Detection for Quantitative System-Level Analysis of Safety-Critical Autonomous Systems
IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2023. [PDF]
CPS-IoT Week Workshop on Perception for Safety-Critical Cyber-Physical Systems, 2023.

2023 **Apurva Badithela***, Josefine Graebener*, Inigo Incer*, and Richard M. Murray.
Reasoning over Test Specifications using Assume-Guarantee Contracts
Proceedings of the 15^{th} *NASA Formal Methods (NFM), 2023, pp 278-294.* [PDF] [DOI]

2023 **Apurva Badithela***, Josefine Graebener*, Wyatt Ubellacker, Eric V. Mazumdar, Aaron D. Ames, and Richard M. Murray.
Synthesizing Reactive Test Environments for Autonomous Systems: Testing Reach-Avoid Specifications with Multi-Commodity Flows
IEEE International Conference on Robotics and Automation (ICRA), 2023. [PDF] [DOI]
Workshop on Envisioning an Infrastructure for Multi-Robot and Collaborative Autonomy Testing and Evaluation, Robotics: Science and Systems (RSS), 2022.

2022 Josefine Graebener*, **Apurva Badithela***, and Richard M. Murray.
Towards Better Test Coverage: Merging Unit Tests for Autonomous Systems.
Proceedings of the 14^{th} *NASA Formal Methods (NFM), 2022, pp 133-155.* [PDF] [DOI]

2021 **Apurva Badithela**, Tichakorn Wongpiromsarn, and Richard M. Murray.
Leveraging Classification Metrics for Quantitative System-level Analysis of Temporal Logic Specifications.
60^{th} *IEEE Conference on Decision and Control (CDC).* [PDF] [DOI]

2019 **Apurva Badithela** and Peter Seiler.
Analysis of the Heavy-ball Algorithm using Integral Quadratic Constraints.
2019 American Control Conference (ACC). [PDF] [DOI]

2017 Austin Nash, **Apurva Badithela**, and Neera Jain.
Dynamic Modeling of a Sensible Thermal Energy Storage Tank with an Immersed Coil Heat Exchanger under Three Operation Modes.
Journal of Applied Energy. [PDF] [DOI]

Honors and Awards

2024– Presidential Postdoctoral Research Fellowship
Highest university-wide postdoctoral fellowship award
Princeton University

2022 CMS and IST Gradient for Change
Department award for contributions toward making Caltech a more diverse, equitable, and inclusive environment.
California Institute of Technology

2022 CMS TA Fellow.
EAS division award to support CMS department TAs in promoting inclusive learning.
California Institute of Technology

2022 RSS Inclusion Fellow
Conference Award
Robotics: Science and Systems

2018 AIAA Guidance, Navigation and Control Undergraduate Conference Experience Award.
American Institute of Aeronautics and Astronautics.

2016-2018 Robert and John McCollum Scholarship.
Department Award
University of Minnesota

2014-2018 Gold Global Excellence Scholarship.
University-wide Award
University of Minnesota

Employment

2021 Autonomy Research Intern in Behavior Planning and Prediction — Motional, Boston
Host: Eric Wolff

Project: Counterexample Guided Repair of Inverse Reinforcement Learning Planner

2017 ICES Moncrief Summer Research Fellow — University of Texas, Austin
Host: Ufuk Topcu
Mentor: Ivan Papusha
Project: Sparse Matrix Methods for Fast Real-time Model Predictive Control

2016 Summer Undergraduate Research Fellowship — Purdue University, West-Lafayette
Host: Neera Jain
Mentor: Austin L. Nash
Project: Dynamic Modeling and Validation of micro-CHP systems

Invited Talks

Dec 2023 Toyota Motor North America R&D. Toyota Research Institute, North America (TRINA).
Nov 2023 Autonomous Systems Lab (ASL) Group Meeting Talk. Stanford University.
Nov 2023 ECE Department Seminar. University of Michigan, Ann Arbor.
Nov 2023 Intelligent Robot Motion Lab (IRoM) Group Meeting Talk. Princeton University.
Oct 2023 Group Meeting Talk. University of Michigan, Ann Arbor.
Dec 2022 National Institute of Informatics, Tokyo.
Oct 2022 40^{th} Southern California Controls Workshop.
Oct 2022 US-Japan Seminar on Autonomy, AI, Robotics, and Informatics.
Mar 2022 VeHiCAL Group Meeting Talk. University of California, Berkeley.
Dec 2020 VeHiCAL Group Meeting Talk. University of California, Berkeley.

Mentoring

Summer 2023 Kimia Hassibi *(SURF)*, Jacob Alderete *(Undergraduate Researcher)*
Project: Difficult test generation and Duckietown hardware

Fall 2021 – present Ranai Srivastav *Undergraduate Researcher (Iowa State)*
Project: Object Detection in Duckietown and Experiments for Validating Object Detection Algorithms

Summer 2022 Andy Dimnaku *(SURF Fellow)*
Project: Optimization of Autonomous Vehicles Testing through Symmetry Mapping

Summer 2022 Edward Zhang, Frida Moreno, Gerard Decker *(FSRI Fellows)*
Project: Setting up Duckietown as a Hardware Platform for Testing Autonomous Vehicles

Summer 2020 Berlin Del Aguila *(WAVE Fellow)*
Project: Synthesis of Static Test Environments for Automated Valet Parking

Teaching

2022–23	CMS TA Fellow
Spring 2022	Teaching Assitant. Optimal Control (CDS 112 / Ae 103a). Caltech
Fall 2020	Teaching Assistant. Linear Systems Theory (CDS 131). Caltech
Fall 2019	Course Ombudsperson. Distributed Computing (CS 142). Caltech

Service

Diversity, Equity and Inclusion

2022–24	CMS H.B. Keller Colloquium Committee Member.
2020–21	Helped organize two workshops on Building Effective Research Collaborations for graduate students.
2021–22	Computing and Mathematical Sciences (CMS) Diversity, Equity and Inclusion (DEI) Steering Committee. Engaged in biweekly discussions on creating initiatives to foster inclusion in the department. Created and organized the CMS Climate Survey on graduate student experience. Organized a department town hall to communicate survey results and solicit feedback from the community. Submitted a written list of recommendations to CMS faculty. The climate survey template is being institutionalized in the CRA database as a reference for other schools.
2019–20	Organized a DEI and anti-racism town hall for CMS students and postdocs, and compiled a written document of recommendations to CMS faculty. Volunteer tutor in math and science for underrepresented students from Pasadena public schools through the Caltech RISE program.
2015–2016	Outreach Officer, AIAA. Organized and coordinated hands-on outreach activities at the Math and Science Family Fun Fair, Farnsworth Aeropsace Magnet and the Girls Inc! Eureka program.

Review Activities

2025	ACM-IEEE International Conference on Cyber-Physical Systems (Poster and Demo Track)
2025	Robotics: Science and Systems (RSS)
2024	Nonlinear Analysis: Hybrid Systems (NAHS)
2023	IEEE Transactions on Intelligent Transportation Systems (T-IST)
2022–25	IEEE International Conference on Robotics and Automation (ICRA)
2023–24	IEEE/RSJ Robotics and Automation Letters (RAL)
2023	IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)
2022	Transactions on Automatic Control (TAC)
2021	60^{th} IEEE Conference on Decision and Control (CDC)