

# Apurva Badithela

apurva@caltech.edu  
abadithela.github.io

## Education

- 2018–  
expected  
2024      Ph.D. in Control and Dynamical Systems      California Institute of Technology  
*Thesis:* Formal Methods for Test and Evaluation of Safety-Critical Autonomous Systems  
*Advisor:* Richard M. Murray  
*Committee:* Aaron D. Ames, Joel W. Burdick, Eric V. Mazumdar, Tichakorn Wongpiromsarn
- 2014–2018      B.S. in Aerospace Engineering and Mechanics      University of Minnesota, Twin-Cities  
*summa cum laude*  
*Advisor:* Peter J. Seiler

## Preprints

- 2023      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  
*Under Review. Submitted to ACM Transactions on Cyber-Physical Systems (T-CPS). ArXiv abs/2303.17751. [PDF][TOOL]*

## Peer-Reviewed Publications

- 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<sup>th</sup> 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 Josefina Graebener\*, Apurva Badithela\*, and Richard M. Murray.  
Towards Better Test Coverage: Merging Unit Tests for Autonomous Systems.  
*Proceedings of the 14<sup>th</sup> 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<sup>th</sup> *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.* [\[PDF\]](#) [\[DOI\]](#)

## 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

- Oct 2023 University of Michigan, Ann Arbor.
- Dec 2022 National Institute of Informatics, Tokyo.
- Oct 2022 40<sup>th</sup> 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.

## Honors and Awards

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

## Mentoring

Summer 2023	Kimia Hassibi ( <i>SURF</i> ), Jacob Alderete ( <i>Undergraduate Researcher</i> ) <i>Project:</i> Difficult test generation and Duckietown hardware
Fall 2021 – present	Ranai Srivastav <i>Undergraduate Researcher (Iowa State)</i> <i>Project:</i> Object Detection in Duckietown and Experiments for Validating Object Detection Algorithms
Summer 2022	Andy Dimnaku ( <i>SURF Fellow</i> ) <i>Project:</i> Optimization of Autonomous Vehicles Testing through Symmetry Mapping
Summer 2022	Edward Zhang, Frida Moreno, Gerard Decker ( <i>FSRI Fellows</i> ) <i>Project:</i> Setting up Duckietown as a Hardware Platform for Testing Autonomous Vehicles
Summer 2020	Berlin Del Aguila ( <i>WAVE Fellow</i> ) <i>Project:</i> Synthesis of Static Test Environments for Automated Valet Parking

## Teaching

Spring 2022	Teaching Assistant. Optimal Control (CDS 112 / Ae 103a).
Fall 2020	Teaching Assistant. Linear Systems Theory (CDS 131).
Fall 2019	Course Ombuds. (CS 144).

## Service

### DIVERSITY, EQUITY AND INCLUSION

2015–2016	Outreach Officer, AIAA. Organized and coordinated hands-on outreach activities at the Math and Science Family Fun Fair, Farnsworth Aerospace Magnet and the Girls Inc! Eureka program.
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. Organized a DEI and anti-racism town hall for CMS students and postdocs, and compiled a written document of recommendations to CMS faculty.
2020–21	Helped organize two workshops on Building Effective Research Collaborations for graduate students.
2022–23	CMS TA Fellow.
2022–24	CMS H.B. Keller Colloquium Committee Member.

### REVIEW ACTIVITIES

2022–24	IEEE International Conference on Robotics and Automation (ICRA)
2023	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 <sup>th</sup> IEEE Conference on Decision and Control (CDC)

## References

Professor Richard M. Murray  
Thomas E. and Doris Everhart Chair  
Control & Dynamical Systems  
Bioengineering  
California Institute of Technology  
Pasadena, California 91125  
murray@cds.caltech.edu

Professor Joel W. Burdick  
Richard L. and Dorothy M. Hayman Chair  
Mechanical Engineering  
Bioengineering  
California Institute of Technology  
Pasadena, California 91125  
jwb@robotics.caltech.edu

Assistant Professor Eric V. Mazumdar  
Computing and Mathematical Sciences  
Economics  
California Institute of Technology  
Pasadena, California 91125  
mazumdar@caltech.edu

Assistant Professor Tichakorn Wongpirom-  
sarn  
Computer Science  
Iowa State University  
Ames, Iowa 50011  
nok@iastate.edu

Professor Aaron D. Ames  
Bren Professor  
Mechanical and Civil Engineering  
Control and Dynamical Systems  
California Institute of Technology  
Pasadena, California 91125  
ames@cds.caltech.edu