Shadi Haddad

PhD in Applied Mathematics

Santa Cruz, CA

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Education

PhD in Applied Mathematics — Santa Cruz, CA
University of California, Santa Cruz — *Dec 2023*

- Applied Mathematics Research Award (2022).
- Chancellor's Fellowship (2019).

MSc in Mechanical Engineering — Tehran, Iran
University of Tehran, College of Mechanical Engineering — *Jan 2018*

- Full Tuition Merit Scholarship.

BSc in Mechanical Engineering — Ahvaz, Iran
Chamran University of Ahvaz, College of Mechanical Engineering — *July 2015*

- Full Tuition Merit Scholarship.

Work & Research

Graduate Student Researcher — UC Santa Cruz — *2019-2023*

- Developed novel optimization methods for control and machine learning.
- Constructed a novel sublinear input neural network (ISNN).
- Introduced customized algorithms for set-based reachability.
- Mastered convex optimization techniques and semidefinite programming.
- Designed optimal stochastic controller integrating optimal mass transport and model predictive control.
- Proposed a stochastic reachability computation framework for occupancy prediction in automated driving.

Teaching Assistant: Nonlinear Dynamical Systems (Grad & Undergrad) — UC Santa Cruz — *Fall 2023 and Fall 2021*

- Designed and delivered weekly lectures on supplementary course materials.
- Guided students with course concepts.
- Designed and evaluated students assignments.

Teaching Assistant: Convex Optimization (Grad) — UC Santa Cruz — *Fall 2022*

- Guided students with course concepts and research-based homework.
- Graded homework and research-oriented final exam.

Teaching Assistant: Mathematical Methods for Engineering II (Undergrad) — UC Santa Cruz — *Winter 2021*

- Designed and delivered weekly lectures on supplementary course materials.
- Guided students with course concepts.
- Evaluated students' assignments.

Graduate Student Researcher — University of Tehran, Iran — *2015-2018*

- Conducted mechanical design of micro-piezoelectric actuator and vibration control.
- Numerically verified a novel observer based fault reconstruction schemes using terminal sliding modes.

Expertise and Skills

- Optimization, Semidefinite Programming (SDP), Machine Learning (ML).
- Optimal Control, Stochastic Control, Model Predictive Control (MPC).
- Numerical Methods, Physical Simulations, Scientific Visualization.
- Reachability Analysis.

Software Languages and Libraries

- MATLAB and Simulink, CVX, Python, Matplotlib, JAX, C++, SOLIDWORKS, ABAQUS.

Publications

Exact Computation of LTI Reach Set from Integrator Reach Set with Bounded Input.
Shadi Haddad, Pansie Khodary, Abhishek Halder. *IEEE Control Systems Letters*, 2024, URL.

The Curious Case of Integrator Reach Sets, Part I: Basic Theory.
Shadi Haddad, Abhishek Halder. *IEEE Transactions on Automatic Control*, 2023, URL.

Convex and Nonconvex Sublinear Regression with Application to Data-driven Learning of Reach Sets.
Shadi Haddad, Abhishek Halder. *American Control Conference*, 2023, URL.

A note on the Hausdorff Distance between Norm Balls and their Linear Maps.
Shadi Haddad, Abhishek Halder. *Set-Valued and Variational Analysis*, 2023, URL.

Certifying the Intersection of Reach Sets of Integrator Agents with Set-valued Input Uncertainties.
Shadi Haddad, Abhishek Halder. *IEEE Control Systems Letters*, 2022, URL.

Density-Based Stochastic Reachability Computation for Occupancy Prediction in Automated Driving.
Shadi Haddad, Abhishek Halder, and Baljeet Singh. *IEEE Transactions on Control Systems Technology*, 2022, URL.

Boundary and Taxonomy of Integrator Reach Sets.
Shadi Haddad, Abhishek Halder. *American Control Conference*, 2022, URL.

Anytime Ellipsoidal Over-approximation of Forward Reach Sets of Uncertain Linear Systems.
Shadi Haddad, Abhishek Halder. *CPS IoT Week Workshop*, 2021, URL.

Prediction and Optimal Feedback Steering of Probability Density Functions for Safe Automated Driving.
Shadi Haddad, Kenneth F Caluya, Abhishek Halder, Baljeet Singh. *IEEE Control Systems Letters*, 2020, URL.

The Convex Geometry of Integrator Reach Sets.
Shadi Haddad, Abhishek Halder. *American Control Conference*, 2020, URL.

Observer Based Fault Reconstruction Schemes Using Terminal Sliding Modes.
M. Mousavi, M. Rahnavard, **Shadi Haddad**. *International Journal of Control*, 2018, URL.

Analytical Study on Nonlinear 3D Coupled Deformations of Tapered FG Micro-beams Accounting for Size Effects.
S. Haddad, M. Baghani. *Iranian Journal of Science and Technology*, 2018, URL.

Talks and Presentations

American Control Conference San Diego, CA, 2023
"Convex and Nonconvex Sublinear Regression with Application to Data-driven Learning of Reach Sets "

IEEE Conference on Decision and Control Cancún, Mexico, 2022
"Certifying the Intersection of Reach Sets of Integrator Agents with Set-valued Input Uncertainties "

American Control Conference Atlanta, GA, 2022
"Boundary and Taxonomy of Integrator Reach Sets"

American Control Conference Virtual, 2021
"Prediction and Optimal Feedback Steering of Probability Density Functions for Safe Automated Driving"

3rd NorCal Control Workshop Virtual, 2021
"The Convex Geometry of Integrator Reach Sets"

American Control Conference Virtual, 2020
"The Convex Geometry of Integrator Reach Sets"

Bay Area Robotics Symposium University of California at Berkeley, 2019
"Understanding the Geometry of Integrator Reach Sets for Robotics Applications"

Honors & Awards

Applied Mathematics Research Award, University of California at Santa Cruz	*Santa Cruz, CA*	2022
Student Travel Award, IEEE Control Systems Society, American Control Conference	*Atlanta, GA*	2022
Advancement to Ph.D Candidacy with Honors, University of California at Santa Cruz	*Santa Cruz, CA*	2022
Student Travel Award, IEEE Control Systems Society, American Control Conference	*New Orleans, LA (Virtual)*	2021
Student Travel Award, IEEE Control Systems Society, American Control Conference	*Denver, CO (Virtual)*	2020
Chancellor's Fellowship, University of California at Santa Cruz	*Santa Cruz, CA*	2019
Full Tuition Merit Scholarship, University of Tehran	*Tehran, Iran*	2015
Full Tuition Merit Scholarship, Chamran University of Ahvaz	*Ahvaz, Iran*	2011

Professional Activities

Reviewer for IEEE Control Systems Letters	2023
Reviewer for Journal of Systems and Control Letters	2023
Reviewer for Journal of Optimization Theory and Applications	2023
Reviewer for 2023 American Control Conference	2023
Reviewer for 2022 IEEE Conference on Decision and Control	2022
Reviewer for 2022 American Control Conference	2022
Reviewer for 2021 IEEE Control Systems Letters	2021
Reviewer for 2021 IEEE Conference on Decision and Control	2021
Reviewer for 2021 CPS IoT Week Workshop on Computation-Aware Algorithmic Design for Cyber-Physical Systems	2021
Reviewer for 2020 IEEE Conference on Decision and Control	2020

Selected Graduate Courses

Machine Learning, Convex Optimization, Nonlinear Control Theory, Applied Optimal Control	*UC Santa Cruz*
Finite Element Method	*University of Tehran*