Shadi Haddad

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Summary

PhD in applied mathematics and MSc in mechanical engineering focused on uncertain systems, machine learning, and control; a strong mathematical background in optimization and dynamical systems; and extensive programming experience implementing numerical simulations, novel neural architectures, and optimization techniques.

Skills

Optimization:	Semidefinite Programming (SDP), Gradient-based and interior point constrained optimization.
Machine Learning:	Nonlinear regression, Neural networks, Reachability analysis.
Control:	Optimal control, Stochastic control, Model predictive control (MPC).
Programming:	Python (incl. NumPy, SciPy, Jax), MATLAB and Simulink.

Education

PhD, Applied Mathematics — Sep 2019 – March 2024
University of California, Santa Cruz — *Santa Cruz, CA*

- Applied Mathematics Research Award • Chancellor's Fellowship • Advancement with Honors

MSc, Mechanical Engineering — Sep 2015 – Jan 2018
University of Tehran — *Tehran, Iran*

- Full Tuition Merit Scholarship

Experience

Graduate Student Researcher — Sept 2019 – March 2024
Applied Mathematics, UC Santa Cruz — *Santa Cruz, CA*

Accomplishments:

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

Graduate Student Researcher — Sep 2015 – Jan 2018
Mechanical Engineering, University of Tehran — *Tehran, Iran*

Accomplishments:

- Conducted mechanical design of micro-piezoelectric actuator and vibration control.
- Designed an observer based fault reconstruction schemes using terminal sliding modes.

Teaching Assistant
UC Santa Cruz
Nonlinear Dynamical Systems, Fall 2023 and Fall 2021 (Grad & Undergrad)
Convex Optimization, Fall 2022 (Grad)

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

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.
Shadi Haddad, Abhishek Halder. *International Journal of Control*, 2018, URL.

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

HONORS & AWARDS

Applied Mathematics Research Award.
University of California at Santa Cruz, 2022.

Student Travel Award.
IEEE Control Systems Society, American Control Conference, 2020-2022.

Advancement to Ph.D Candidacy with Honors.
University of California at Santa Cruz, 2022.

Chancellor's Fellowship.
University of California at Santa Cruz, 2019.

Full Tuition Merit Scholarship.
University of Tehran, 2015.

Ranked top 1% among more than 20,000 applicants in nationwide universities entrance exam for Mechanical Engineering graduate studies.
Iran, 2015.

Ranked top 1% among more than 340,000 applicants in nationwide universities entrance exam for undergraduate studies.
Iran, 2011.

Talks & and Professional Activities

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

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

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

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

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

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

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

Reviewer for Journal of Systems and Control Letters, 2023, 2024.

Reviewer for IEEE Conference on Decision and Control, 2020-2024.

Reviewer for Journal of Optimization Theory and Applications, 2023.

Reviewer for American Control Conference, 2022, 2023.

Reviewer for IEEE Control Systems Letters, 2021, 2023.