

# Shadi Haddad

✉ [shhaddad@ucsc.edu](mailto:shhaddad@ucsc.edu) | 🏠 [shadihdd.github.io](https://github.com/shadihdd) | 🌐 [shadi-haddad](https://shadi-haddad.com)

## SUMMARY

PhD in Applied Mathematics focused on uncertain systems, machine learning, and control with applications to autonomous driving. Strong mathematical background in optimization and dynamical systems as well as extensive programming experience implementing high-performance numerical simulations, novel neural architectures, and optimization techniques.

## EDUCATION

### PhD, Applied Mathematics & Statistics

University of California, Santa Cruz

Sep 2019 – March 2024

Santa Cruz, CA

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

### MSc, Mechanical Engineering

University of Tehran

Sep 2015 – Jan 2018

Tehran, Iran

- Full Tuition Merit Scholarship

## SKILLS

Optimization:

Semidefinite programming (SDP), Constrained optimization,

Machine Learning:

Nonlinear regression, Geometry/Physics-Informed neural networks, Reachability analysis

Control Theory:

Optimal control, Stochastic control, Model predictive control (MPC),

Optimal mass transport, Schrödinger bridge

High Performance Computing:

Python (incl. NumPy, SciPy, Jax), MATLAB, C++

Software:

SolidWorks, Abaqus FEA, git

## EXPERIENCE

### Data Scientist and Analytics Consultant

OPTAPT LLC

Sept 2024 – Present

Remote, USA

- Product inventory planning using constrained optimization methods.
- Statistical analysis of product reviews using open-source Large Language Models (LLMs).

### Graduate Student Researcher

UC Santa Cruz

Sep 2019 – March 2024

Santa Cruz, CA

- Introduced the sublinear input neural network (ISNN) architecture (output function is sublinear in input data).
- Developed custom algorithms for set-based reachability, improving accuracy by 20-30% over leading methods.
- Proposed a probabilistic learning approach to estimate the reach sets of feedback linearizable systems.
- Devised novel reach set intersection detection methods for feedback linearizable systems.
- Established upper bounds for the expected Hausdorff distance between linear time varying control systems.

### Team Leader

Ford University Research Project, Ford Greenfields Lab

Sept 2020 – March 2022

Palo Alto, CA

- Proposed a non-parametric stochastic prediction method with 30% runtime speedup over Monte Carlo in an automated driving highway case study.
- Designed a prediction and optimal feedback control framework for stochastic reachability in multi-lane automated driving.

### Graduate Student Researcher

Mechanical Engineering, University of Tehran

Sep 2015 – Jan 2018

Tehran, Iran

- Designed micro-piezoelectric actuator and performed vibration control.
- Designed an observer-based fault reconstruction scheme using terminal sliding modes to guarantee asymptotic system convergence.
- Derived the analytical solution for a nonlinear model of a functionally graded tapered micro-bridge using the Homotopy-Padé technique.
- Increased axial deflection of micro-beam by 18% and improved model of natural frequency by considering small scale effects, nonlinear mid-plane stretching, and lateral deflections.

## 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.

Mohammad Mousavi, Mostafa 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.

**Shadi Haddad**, Mostafa Baghani, M.R. Zakerzadeh. *Iranian Journal of Science and Technology*, 2018, [URL](#).

## PERSONAL PROJECTS

---

### Procedural Terrain Generation with Convolutional Neural Networks

- A neural network-based system for generating realistic terrain maps, with output integrated into voxel rendering engines.

### Stochastic Optimal Control for Microchip Design

- A stochastic control framework to optimize design parameters in microchip architecture.

### An Interactive Geometric Design Tool

- A browser-based tool for creating and manipulating geometric patterns, focusing on real-time user interaction and visual aesthetics.

## TEACHING EXPERIENCE

---

### Teaching Assistant, UC Santa Cruz

*Computational Methods and Applications*, Winter 2024 (Undergrad)

*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.

### Mathematics Instructor, Iran

- Prepared students for entry into Exceptional Talent High Schools, 2016-2018.

## HONORS & AWARDS

---

Applied Mathematics Research Award.

*University of California at Santa Cruz, 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.*

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.*

Schrödinger meets Kuramoto via Feynman-Kac: Minimum effort distribution steering for noisy nonuniform Kuramoto oscillators.

*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 IEEE Conference on Decision and Control, 2025, 2022, 2021, 2020.

**Reviewer** for ASME Journal of Dynamic Systems, Measurement and Control, 2025

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

**Reviewer** for Journal of Optimization Theory and Applications, 2023.

**Reviewer** for American Control Conference, 2023, 2022.

**Reviewer** for IEEE Control Systems Letters, 2023, 2021.