# He Yin

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https://scholar.google.com/citations?user=hKMVC8IAAAAJ&hl=en

## Education

***Ph.D.** candidate*, Mechanical Engineering, **University of California, Berkeley** Aug. 2016 - present

- Major: Control Systems, Minors: Optimization and Learning
- Advisors: Andrew Packard, Murat Arcak
- Courses: Convex Optimization & Algorithm, Deep Reinforcement Learning, Machine Learning, Nonlinear Control, System Theory, Learning & Optimization, Linear Systems, State Estimation, Dynamic Programming

***B.Sc.***, Mechanical Engineering, **Harbin Institute of Technology** July 2016

## Research

**Robustness analysis of dynamical systems with Neural Network Controllers** [1]

- Integral quadratic constraints (IQC), a mathematical tool from the field of Robust Control, are used to characterize the properties of activation functions in the NNs. A framework that merges IQCs and Lyapunov theory is proposed to analyze the robust performance of systems with NN controllers.

**Safe learning of Regions of Attraction for Uncertain Nonlinear Systems** [2]

- A framework that merges Gaussian process (GP) and sum-of-squares programming is proposed to compute the regions of attraction for uncertain systems. GP with polynomial kernels is utilized to model the uncertainties in the systems. A safe exploration controller is designed to safely gather data points for the GP model.

**Safe-by-Design Approach to Path Planning-Tracking for Robotics Systems** [5–7]

- Developed a framework to achieve the most permissive planner while guaranteeing safety of the system.
- Parametrized the constraint sets used for MPC planner and derived the corresponding parametrized tracking control law and error bounds. Chose the best parameter to allow for the largest constraint sets.

**Reachability Analysis and Control Synthesis for Nonlinear Dynamical Systems** [4, 8–10]

- Developed a method of computing forward/backward reachable sets for uncertain nonlinear systems.
- Proposed a method of synthesizing controllers for a system to reach the target set while avoiding obstacles.
- The reachable set and controller are computed simultaneously using sum-of-squares (SOS) programming.

## Publications

[1] He Yin*, Peter Seiler, Murat Arcak, “Stability Analysis using Quadratic Constraints for Systems with Neural Network Controllers”, *submitted to IEEE Transactions on Automatic Control, arXiv: 2006.07579.*

[2] Alex Devonport, He Yin, Murat Arcak, “Bayesian Safe Learning and Control with Sum-of-Squares Analysis and Polynomial Kernels”, *submitted to the 59th IEEE Conference on Decision and Control,* 2020, *arXiv: 2004.00662*.

[3] Emmanuel Sin*, He Yin*, Murat Arcak, “Passivity-based distributed acquisition and station-keeping control of a satellite constellation in areostationary orbit”, *to appear in Dynamic Systems & Control Conference 2020.*

[4] He Yin*, Peter Seiler, Murat Arcak, “Backward Reachability using Integral Quadratic Constraints for Uncertain Nonlinear Systems”, *accepted by IEEE Control Systems Letters (L-CSS), arXiv: 2003.05617*.

[5] Pierre-Jean Meyer*, He Yin, Astrid H Brodtkorb, Murat Arcak, Asgeir J Sørensen, “Continuous and discrete abstractions for planning, applied to ship docking”, *to appear in IFAC 2020, Berlin, Germany.*

[6] H. Yin*, M. Bujarbaruah, M. Arcak, A. Packard, “Optimization Based Planner–Tracker Design for Safety Guarantees,” *to appear in 2020 American Control Conference, Denver, USA.*

[7] S. Smith*, H. Yin*, and M. Arcak, “Continuous abstraction of nonlinear systems using sum-of-squares programming,” in *Proceedings of the 58th IEEE Conference on Decision and Control,* 2019, pp. 8093-8098.

[8] H. Yin*, A. Packard, M. Arcak, and P. Seiler, "Finite horizon backward reachability analysis and control synthesis for uncertain nonlinear systems," in *Proceedings of the 2019 American Control Conference*, 2019, pp. 5020-5026.

[9] H. Yin*, M. Arcak, A. Packard, and P. Seiler, “Backward reachability for polynomial systems on a finite horizon,” *submitted to IEEE Transactions on Automatic Control, preprint arXiv:1907.03225, 2019.*

[10] H. Yin*, M. Arcak, A. Packard, and P. Seiler, “Reachability analysis using dissipation inequality for uncertain nonlinear systems,” *Systems & Control Letters, vol. 142, 2020.*

## Invited talks

CITRIS/CPAR Control Theory and Automation Symposium, April 26th, 2019

## Professional activities

**Conference reviewer:** American Control Conference, International Federation of Automatic Control, Conference on Decision and Control, Symposium on Mathematical Theory of Networks and Systems, Joint Mechatronics 2019 & NolCoS 2019

**Journal reviewer:** IEEE Control Systems Letters

## Experiences

**TuSimple, Inc** San Diego, CA
***Research Engineer Intern*** June 2020 - Aug. 2020

- System identification and robust control design for autonomous-driving trucks.

**TuSimple, Inc** San Diego, CA
***Vehicle Control Intern*** May 2017 - Aug. 2017

- Designed and implemented Model Predictive Control based Adaptive Cruise Control algorithm to provide speed profile and waypoint reference for the low-level controller to track.
- Designed the low-level controller using MPC and implemented it in ROS using Python and Julia.
- Tested the autonomous vehicle on various kinds of road conditions, including local roads, highways.

***Graduate Student Instructor*** for ME 231A (graduate course at Berkeley) Aug. 2016 - Dec. 2016

- Taught LQR, Dynamic Programming, Model Predictive Control, and Loop Shaping

## Technical skills

**Interests:** Robust Control, Model Predictive Control (MPC), Nonlinear Control, Sum-of-Squares and Semidefinite Programming, Multi-agent Systems, LQR, Kalman Filter, System Identification

**Languages:** MATLAB/Simulink, Python, Julia, ROS

## Honors

Berkeley Graduate Division Block Grant Award