

Yuhao Zhang

PhD Candidate in Mechanical Engineering

University of Wisconsin-Madison

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SUMMARY

PhD candidate in Mechanical Engineering at the University of Wisconsin-Madison. Specializing in formal analysis, verification, and control design for autonomous systems and learning-enabled systems to ensure reliability and performance in real-world applications.

EDUCATION

University of Wisconsin-Madison

Madison, WI

Doctor of Philosophy in Mechanical Engineering

Sep 2020 – Dec 2025 (expected)

- Advisor: Prof. Xiangru Xu
- GPA: 4.00/4.00
- Thesis (tentative): Formal Analysis and Verification of Neural Network Control Systems

University of Michigan-Ann Arbor

Ann Arbor, MI

Master of Science in Engineering in Mechanical Engineering

Sep 2017-May 2019

- Advisor: Prof. Necmiye Ozay and Prof. Jean-Baptiste Jeannin
- GPA: 4.00/4.00
- Project: Vision-based Autonomous Taxiing and Landing of Aircraft

Peking University

Beijing, China

Bachelor of Engineering in Energy and Power Engineering

Sep 2013-Jun 2017

Bachelor of Economics (Double Degree)

Sep 2014-Jun 2017

- Advisor: Prof. Jianchun Mi
- GPA: 3.46/4.00
- Thesis: Experimental and Simulation Research on MILD Combustion Properties in Methanol Boilers

EXPERIENCE

University of Wisconsin-Madison

Madison, WI

Research Assistant at Autonomous & Resilient Controls Lab

Sep 2020-Present

- Developed rigorous analysis and control methodologies to ensure the reliability of autonomous intelligent systems, such as self-driving cars and quad-rotors.
- Employed optimal control and robust control techniques to design safe control algorithms for systems with various types of uncertainties.
- Conducted numerical simulations in MATLAB and Python for dynamic systems, including autonomous vehicles and robots.
- Designed and tested control algorithms in quadcopter experiments to ensure safety through effective obstacle avoidance.
- Proposed provable stability conditions for Neural Network Control Systems with dynamics uncertainties.

- Implemented optimization-based techniques for formal safety verification and reachability analysis of controlled systems with Artificial Neural Network components.

University of Michigan-Ann Arbor

Research Associate

Ann Arbor, MI

Sep 2018-Jun 2020

- Designed a high-level software architecture for autonomous taxiing and landing of aircraft.
- Implemented separate modules for the proposed architecture, including a path-finding algorithm, a taxi-way waypoint generator, and a low-level tracking controller based on Model Predictive Control (MPC).
- Employed falsification techniques to evaluate the performance of the designed controllers.

University of Michigan-Ann Arbor

Course Project - Self-driving Cars: Perception and Control

Ann Arbor, MI

Sep 2017-Dec 2017

- Designed a controller for a bicycle model to follow a pre-defined track as rapidly as possible.
- Developed a control algorithm based on MPC to avoid obstacles known only at run-time.

Peking University

Undergraduate Research Assistant

Beijing, China

Feb 2016-Jun 2017

- Simulated combustion in traditional boilers and studied the environmental influence of pollution.
- Experimental and simulation study of methanol MILD combustion in boilers, achieving higher thermal efficiency and lower pollution production.

The Chinese University of Hong Kong

Summer Research Intern

Hong Kong

Jul 2016-Aug 2016

- Worked on harvesting kinetic energy from human motion and vibrations, advised by Prof. Wei-Hsin Liao.

SKILLS

Programming: MATLAB, Python, C++, C

Software/Tools: Simulink, SolidWorks, PyTorch, Gurobi, Linux, CUDA+0, FEM, Git

Hardware: Crazyflie quadrotor, Raspberry Pi, Arduino

Language: English, Chinese (Mandarin)

PROFESSIONAL SERVICE

Grader

- ECE 560 - Linear Systems Theory at the University of Michigan-Ann Arbor

Journal Reviewer

- Automatica
- IEEE Transactions on Control Systems Technology (TCST)
- IEEE Control Systems Letters (L-CSS)
- Systems & Control Letters
- Control Engineering Practice

Conference Reviewer

- IEEE Conference on Decision and Control (CDC)
- American Control Conference (ACC)
- IEEE International Conference on Robotics and Automation (ICRA)
- Annual Learning for Dynamics and Control Conference (L4DC)

PUBLICATIONS

Journal Publications

- J1. **Yuhao Zhang**, Xiangru Xu, “Robust Stability of Neural Network Control Systems with Interval Matrix Uncertainties”, *Automatica*, 177: 112289, 2025. <https://doi.org/10.1016/j.automatica.2025.112289>
- J2. **Yuhao Zhang**, Hang Zhang, Xiangru Xu, “Reachability Analysis of Neural Network Control Systems with Tunable Accuracy and Efficiency”, *IEEE Control Systems Letters*, 8: 1697-1702, 2024. <https://doi.org/10.1109/LCSYS.2024.3415471>
- J3. **Yuhao Zhang**, Hang Zhang, Xiangru Xu, “Backward Reachability Analysis of Neural Feedback Systems Using Hybrid Zonotopes”, *IEEE Control Systems Letters*, 7: 2779-2784, 2023. <https://doi.org/10.1109/LCSYS.2023.3289572>

Peer-reviewed Conference Publications

- C1. **Yuhao Zhang**, Xiangru Xu, “Efficient Reachability Analysis for Convolutional Neural Networks Using Hybrid Zonotopes”, *American Control Conference*, Denver, CO, USA, 2025. (accepted) <https://arxiv.org/pdf/2503.10840>
- C2. Hang Zhang, **Yuhao Zhang**, Xiangru Xu, “Hybrid Zonotope-Based Backward Reachability Analysis for Neural Feedback Systems With Nonlinear Plant Models”, *American Control Conference*, Toronto, ON, Canada, page 4155–4161, 2024. <https://doi.org/10.23919/ACC60939.2024.10644573>
- C3. **Yuhao Zhang**, Xiangru Xu, “Reachability Analysis and Safety Verification of Neural Feedback Systems via Hybrid Zonotopes”, *American Control Conference*, San Diego, CA, USA, page 1915–1921, 2023. <https://doi.org/10.23919/ACC55779.2023.10156417>
- C4. **Yuhao Zhang**, Xiangru Xu, “Safety Verification of Neural Feedback Systems Based on Constrained Zonotopes”, *IEEE Conference on Decision and Control*, Cancun, Mexico, page 2737-2744, 2022. <https://doi.org/10.1109/CDC51059.2022.9992655>
- C5. **Yuhao Zhang**, Sequoyah Walters, Xiangru Xu, “Control Barrier Function Meets Interval Analysis: Safety-Critical Control with Measurement and Actuation Uncertainties”, *American Control Conference*, Atlanta, GA, USA, page 3814–3819, 2022. <https://doi.org/10.23919/ACC53348.2022.9867681>
- C6. Sara Shoouri, Shayan Jalili, Jiahong Xu, Isabelle Gallagher, **Yuhao Zhang**, Joshua Wilhelm, Jean-Baptiste Jeannin, Necmiye Ozay, “Falsification of a Vision-based Automatic Landing System”, *AIAA SciTech Forum*, 2021. <https://doi.org/10.2514/6.2021-0998>
- C7. **Yuhao Zhang**, Guillaume Poupert-Lafarge, Huaiyuan Teng, Joshua Wilhelm, Jean-Baptiste Jeannin, Necmiye Ozay, Eelco Scholte, “A Software Architecture for Autonomous Taxiing of Aircraft”, *AIAA SciTech Forum*, 2020. <https://doi.org/10.2514/6.2020-0139>

Preprints

- P1. **Yuhao Zhang**, Xiangru Xu, “Finding Matrix Sequences with a High Asymptotic Growth Rate for Linear Constrained Switching Systems”, *arXiv:2009.12948*, 2021. <https://arxiv.org/abs/2009.12948>

COURSES

Nonlinear Optimization, Dynamic Programming, High Performance Computing, Advanced Computational Dynamics, Linear System Theory, Robot Kinematics and Dynamics, Self-Driving Cars: Perception and Control

LEADERSHIP AND COMMUNITY SERVICE

Engineering EXPO

Madison, WI

Student Exhibitor

Apr 2023

- Demonstrated quadrotor experiments to middle school students, earning the Honorable Mention Award.

Practice Department in College of Engineering

Beijing, China

Vice President

Sep 2014-Jun 2015

- Organized summer internship programs and coordinated local company visits for undergraduates.

AWARDS AND ACHIEVEMENTS

Student Research Grants Competition Award

University of Wisconsin-Madison Graduate School

Jun 2025

Student Research Grants Competition Award

University of Wisconsin-Madison Graduate School

Apr 2023

LeRoy Fellowship

Department of Mechanical Engineering, University of Wisconsin-Madison

Sep 2023

XIA Shouyu and HUANG Yuqin Scholarship

College of Engineering, Peking University

May 2016

Community Service Award

College of Engineering, Peking University

Dec 2015

Second prize in National High School Mathematics Competition

Chinese Mathematical Society

Nov 2012