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, graduating in August 2025. Specializing in formal analysis, verification, and control design for autonomous systems and learning-enabled systems to ensure safety in real-world applications.

EDUCATION

University of Wisconsin-Madison	Madison, WI
Doctor of Philosophy in Mechanical Engineering	Sep 2020 – Present
• Advisor: Prof. Xiangru Xu	
• GPA: 4.00/4.00	
• Research Interest: Analysis, verification and control design for safety-crit enabled systems	tical systems and learning-
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

Research Assistant at Autonomous & Resilient Controls Lab

- 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.

Madison, WI

Sep 2020-Present

- 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

- 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

- 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

- 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

• 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, 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

- 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)

Ann Arbor, MI Sep 2018-Jun 2020

Beijing, China

Ann Arbor, MI

Sep 2017-Dec 2017

Hong Kong

Feb 2016-Jun 2017

Jul 2016-Aug 2016

PUBLICATIONS

Journal Publications

- J1. Yuhao Zhang, Xiangru Xu, "Robust Stability of Neural Feedback Systems with Interval Matrix Uncertainties", *Automatica*, 2024. (Provisionally accepted) https://arxiv.org/abs/2311.15109
- 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. 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
- C2. 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
- C3. 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
- C4. 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
- C5. 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
- C6. Yuhao Zhang, Guillaume Poupart-Lafarge, Huaiyuan Teng, JoshuaWilhelm, 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 Student Exhibitor Demonstrated quadrotor experiments to middle school students, earning Award. 	Madison, WI Apr 2023 the Honorable Mention
 Practice Department in College of Engineering Vice President Organized summer internship programs and coordinated local company visi 	Beijing, China Sep 2014-Jun 2015 ts for undergraduates.

Awards and Achievements

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