Yuhao Zhang

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1513 University Ave, Room 3158, Madison, WI 53706

Education

University of Wisconsin-Madison Madison, WI

Doctor of Philosophy in Mechanical Engineering *Sep 2020 – Present*

- Advisor: Prof. Xiangru Xu
- Research Interest: Analysis, verification and control design for safety-critical systems and learning-enabled 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
- 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*

- Advisor: Prof. Jianchun Mi
- Thesis: Experimental and Simulation Research on MILD Combustion Properties in Methanol Boilers
- Double Degree: Bachelor of Economics

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 Ann Arbor, MI

Research Associate *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 Ann Arbor, MI

Course Project - Self-driving Cars: Perception and Control *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 Beijing, China

Undergraduate Research Assistant at Laboratory of Turbulence & Complex Systems *Feb 2016-Jun 2017*

- Simulated combustion in traditional boilers and summarize 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 Hong Kong

Summer Research Intern at Department of Mechanical and Automation Engineering *Jul 2016-Aug 2016*

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

Representative Publications

Yuhao Zhang, Xiangru Xu, ***"Robust Stability of Neural Feedback Systems with Interval Matrix Uncertainties"***, Automatica, 2024. (Provisionally accepted)

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.

Yuhao Zhang, Hang Zhang, Xiangru Xu, ***"Backward Reachability Analysis of Neural Feedback Systems Using Hybrid Zonotopes"***, IEEE Control Systems Letters, 7: 2779-2784, 2023.

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.

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.

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.

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.

Skills

Software/Programming: MATLAB, Python, C++, C, Simulink, SolidWorks, PyTorch, Linux, CUDA, FEM

Hardware: Crazyflie quadrotor, Raspberry Pi, Arduino

Language: English, Chinese (Mandarin)

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 — *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*

Courses

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