

# MR. ZHANG, HANG

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## EDUCATION

Harbin Institute of Technology (HIT, enlisted in “985 Project” and “211 Project”) Harbin, CHN  
*Bachelor of Engineering in Automation* Sep. 2015 - Jun. 2019

- Undergraduate Cumulative GPA: 3.79/4.0, major GPA: 3.95/4.0
- 3<sup>rd</sup> Prize People Merit-based Scholarship (top 10%), Jun. 2017, Sep. 2017, Jun. 2018
- 2<sup>nd</sup> Prize People Merit-based Scholarship (top 7%), Jun. 2016

University of Michigan Ann Arbor, US  
*Master of Science in Electrical and Computer Engineering* Jan. 2020 - Dec. 2021

- Graduate GPA (till now): 4.0/4.0

University of Wisconsin - Madison Madison, US  
*Ph.D. student in Mechanical Engineering* Sep. 2022 - Till Now

- Research Focus: Control theory and learning method, with application in safety verification for safety-critical systems.
- Graduate GPA (till now): 4.0/4.0

## RESEARCH EXPERIENCES

UW Autonomous & Resilient Controls (ARC) Lab Sep. 2022-Till Now

- Focusing on backward reachability analysis for neural network systems.

Collins Aerospace project for machine understanding of human behavior Sep. 2021-Aug. 2022

- Injected the description of abnormal behaviors from human-domain expert knowledge into learning methods via the introduction of parametric Signal Temporal Logic (pSTL) formulas.
- Implemented a deep learning algorithm to obtain learned STL formula for describing or classifying different human behaviors.
- Solved human behavior classification problems via the learned STL criterion from deep neural network models with the IMU data from human behaviors.

Reachability analysis for falsification of Baron58 airplane linearized system Mar. 2021-Jun. 2022

- Used Hamilton-Jacobi-Bellman (HJB) level set method to compute backward reachable sets, which is used for safety verification and falsification, for the identified system.
- Compared various reachability analysis methods such as the HJB method and the zonotope-based method, and study the differences between them.
- Implemented sequential linearization and splitting procedure to extend the zonotope-based reachability analysis method, which is used for linear systems, to nonlinear systems.
- Implemented sequential linearization and splitting procedure to extend the zonotope-based reachability analysis method to constrained-zonotope-based reachability analysis.

HIT Intelligent Control Lab Mar. 2017-Sep. 2019

- Implemented an objective extraction algorithm for manipulator cameras based on traditional computer vision techniques.
- Learned system identification methods and machine learning methods, and implemented them for the programs concerning identifying control systems and conducted simulation in MATLAB.
- Programmed the interactive interface of the painting robot system, which is used to read and operate the coordinates of robotic manipulators, based on Point Cloud Library (PCL) in C++.

## **SYSTEM DESIGN PROJECTS**

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Particle filter based localization using NCLT and KITTI dataset

Apr. 2021

(Project for EECS 568 - Mobile Robotics)

- Implemented poles extraction algorithm based on KITTI dataset and NCLT dataset.
- Implemented particle filter and unscented Kalman Filter based (UKF-based) particle filter to estimate the position of the robot.
- Implemented an algorithm to generate global landmarks maps with the combination between extracted poles and estimated positions.
- Evaluated the performance of both the particle filter and the UKF-based particle filter.

Transformer-based image to LaTeX OCR

Apr. 2021

(Project for EECS 545 - Machine Learning)

- Constructed CNN-Transformer network to train the sequence prediction model.
- Made comparisons between our model and traditional natural language processing models such as RNN and LSTM.
- Achieved the goal that given the formula image as input, the prediction of corresponding LaTeX codes can be obtained via the trained model.

Gaming AI for Jump King based on Reinforcement Learning

Dec. 2020

(Project for EECS 598-003 - Reinforcement Learning Theory)

- Used DDQN and TD3 algorithm to train the gaming agent.
- Achieved the goal that the agent can jump to higher platforms and avoid invalid jumping or falling down.

Design of optimal switching sequences of fixed DMPs for optimal path generation

Dec. 2020

(Project for EECS 563 - Hybrid Control)

- Defined the cost function and searched for the optimal switching sequence in one-switching case via nonlinear programming method.
- Used SARSA algorithm to find the optimal switching sequence and optimal path in multi-switching case.

Semantic mapping with LiDAR point cloud and RGB images

Apr. 2020

(Project for EECS 504 - Foundations of Computer Vision)

- Used U-Net to implement semantic segmentation of mapping images.
- Constructed 3-D maps based on segmentation and LiDAR information

Design of visual servo system for UAV

Sep. 2019

- Used computer vision tool (OpenCV) to find the geometric center of a moving object simultaneously.
- Designed the PID controller to track the moving object.
- Simulated the trajectory in Webots and computed the tracking errors in MATLAB.

## **PROFESSIONAL EXPERIENCES**

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University of Wisconsin - Madison

Madison, US

*Faustin Prinz Fellow*

Sep. 2022-Till Now

- Pursuing Ph.D. degree and engaging in control society under my advisor Prof. Xiangru Xu.

University of Michigan

Ann Arbor, US

*Graduate Student Research Assistant, 20 hours/week*

Oct. 2021-Till Now

- Worked on the project from Collins Aerospace under the supervision of Prof. Necmiye Ozay
- Implemented a logic-based method to describe or classify different human behaviors.

*Grader for ROB 501 (Mathematics for Robotics), 10 hours/week*

Sep. 2021-Oct.2021

- Graded assignments for students and clarify the mistakes in assignments.

*Grader for EECS 560 (Linear System Theory), 12 hours/week*

Jan. 2021-May 2021

- Graded assignments for students and clarify the mistakes in assignments.

Emerson Process Control Co., Ltd., Power & Water Solution Department

Beijing, CHN

*Intern PWS Proposal Engineer, 40 hours/week*

Jul. 2018-Aug. 2018

- Got trained about Ovation System and DCS.
- Provided pre-sales technical support, helped the supervisor to develop bidding documents and proposals.
- Helped the mentor to choose the proper equipment so as to meet the industrial demand.

The 3<sup>rd</sup> China Aerospace Science and Technology Institute, No. 33 Research Institute

Beijing, CHN

*Trainee, 36 hours/week*

Jul. 2018

- Learned knowledge about platform inertial navigation system and strap-down inertial navigation system.
- Learned basic principles and the productive processes of various kinds of gyroscopes and accelerometers.
- Implemented basic Strap-down inertial navigation algorithm.

## **EXTRACURRICULAR ACTIVITIES**

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- The Tutorial Class for Students with Obstacles in Academic Courses, *Tutor*, Sep. 2015-Sep. 2018
- The Welcome Event for freshmen, HIT, *Volunteer*, Sep. 2015-Oct. 2015

## **PUBLICATIONS**

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- Xin Liu, Hang Zhang, Pengbo Zhu, Xianqiang Yang, Zhiwei Du, Identification of Nonlinear State-space Time-delay System, *Assembly Automation*, ISSN 0144-5154, Jun. 2019
- Zhu, Pengbo, Xianqiang Yang, and Hang Zhang. "Mixture robust L1 probabilistic principal component regression and soft sensor application." *The Canadian Journal of Chemical Engineering* 98.8 (2020): 1741-1756.
- Liren Yang, Hang Zhang, Jean-Baptiste Jeannin, and Necmiye Ozay. "Efficient Backward Reachability Using the Minkowski Difference of Constrained Zonotopes." *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems* 41.11 (2022): 3969-3980

## **AWARDS & HONORS**

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- Faustin Prinz Fellowship, Sep. 2022

## **ADDITIONAL INFORMATION**

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- Language: native speaker of Mandarin, proficient in English
- Computer skills: MATLAB, C, C++, CUDA programming, Python.