GUOXIANG ZHAO

224 Electrical Engineering West, University Park, PA 16802
+1(765)237-2160 ⋄ gfz5014@psu.edu ⋄ https://www.personal.psu.edu/gfz5014/

EDUCATION

Pennsylvania State University *University Park, PA*
Ph.D. in Electrical Engineering May 2022
GPA: 3.78/4
Dissertation title: Multi-robot optimal motion planning

Purdue University *West Lafayette, IN*
Master of Science in Mechanical Engineering May 2015
GPA: 3.81/4

Shanghai Jiao Tong University *Shanghai, China*
Bachelor of Engineering in Mechanical Engineering & Automation June 2014
GPA: 87.4/100

RESEARCH INTERESTS

Multi-robot systems, robotic motion planning, distributed control, optimal control, nonlinear control, machine learning.

RESEARCH EXPERIENCES

Distributed optimal motion planning with dependent goals March 2019 - Present

· A distributed algorithm is proposed to command mobile robots in a constrained space to goals with minimal cost;
· Asynchronous policy iterations are executed where robots only share value functions and policies without disclosing local information and convergence to optimal policy in the continuous state space is formally guaranteed;
· The distributed update fashion relieves the algorithm's dependency of computational complexity on robot number and makes it more flexible about robot dynamics and objectives.

Distributed safe reinforcement learning for multi-robot motion planning August 2020 - March 2021

· A distributed reinforcement learning algorithm is proposed to coordinate multiple mobile robots;
· Anytime collision avoidance, uniform and ultimate boundedness of system states and convergence of neural network controller weights are formally guaranteed via Lyapunov analysis;
· Simulations show both 10 single integrators and unicycle robots can safely arrive at goal regions.

Distributed multi-robot near-optimal motion planning March 2018 - February 2019

· A scalable algorithm is designed to navigate a large fleet of unicycle robots to their goal regions in cluttered environment and maintain a safe distance between any two robots and a robot-obstacle pair;
· Computational complexity is independent of robot number and all robots are guaranteed to reach their destinations without causing any collisions;
· Simulations demonstrate the scalability of the algorithm using 25 unicycle robots and also show minor optimality losses compared to globally optimal solutions.

Anytime multi-robot optimal motion planning June 2016 - February 2018

· A numerical algorithm is proposed to guide a team of mobile robots subject to general nonlinear dynamics arrive at their respective goal sets without causing any collisions in cluttered environment;
· Via set-valued analysis, each robot's safe arrival at goal set with minimal traveling time is ensured;
· Computer simulations and real-world experiments with Khepera III robots and Vicon system on a four-way intersection show that the numerical algorithm has anytime property.

Functional printing control January 2014 - May 2015

· A printing motion control interface EZPrinting is developed to synthesize a HP Thermal Inkjet Printing System with its motion platform for large size printing tasks;
· It automatically calibrates printing motion platform for user specified missions and evaluates printing quality;
· EZPrinting facilitates inkjet surface-functionalized printing technologies and successfully produces test strips for detecting food-borne pathogens.

PUBLICATIONS

- **Journal papers**

  [J2] **Zhao, G.** & Zhu, M. (2020). **Scalable distributed algorithms for multi-robot near-optimal motion planning**. *Automatica*, vol. 140, Article 108637, June 2022. https://doi.org/10.1016/j.automatica.2022.110241

  [J1] **Zhao, G.** & Zhu, M. (2020). **Pareto optimal multi-robot motion planning.** *IEEE Transactions on Automatic Control*, vol. 66, no. 9, pp. 3984-3999, Sept. 2021. https://ieeexplore.ieee.org/document/9204457

- **Conference papers**

  [C3] Lu, Y., Guo, Y., **Zhao, G.** & Zhu, M. (2021). **Distributed safe reinforcement learning for multi-robot motion planning**. In *29th Mediterranean Conference on Control and Automation*, 1209-1214, Bari, Italy.

  [C2] **Zhao, G.** & Zhu, M. (2019). **Scalable distributed algo-rithms for multi-robot near-optimal motion planning.** In *58th IEEE Conference on Decision and Control*, 226–231, Nice, France.

  [C1] **Zhao, G.** & Zhu, M. (2018). **Pareto optimal multi-robot motion planning.** *2018 American Control Conference*, 4020-4025, Milwaukee, WI.

- **Working papers**

  [W1] **Zhao, G.**, Lu, Y., & Zhu, M. (2021). **Distributed optimal motion planning with dependent goals**.

HONORS AND AWARDS

- Dean's List and Semester Honors, College of Engineering
  Purdue University 2014
- Sun Hung Kai Scholarship
  Shanghai Jiao Tong University 2011-2014
- Timken Scholarship
  Shanghai Jiao Tong University 2012
- B-Level Merit Scholarship Award Top 5%
  Shanghai Jiao Tong University 2013

COMPUTER SKILLS

Python, Javascript/Typescript/React/Ant Design, MATLAB, Tensorflow, MongoDB, AWS CLI, Airflow

COURSEWORK

Control & Optimization	Linear Control Systems, Dynamical Systems and Control, Nonlinear Systems, Adaptive and Learning Systems, System Identification, Convex Optimization, Stochastic Optimization
Robotics & Mechatronics	Microprocessing Electromechanical Systems, Human Motion Kinetics, Robotics, Electromechanical Motion Devices, Control of Functional Printing
Machine Learning	Pattern Recognition and Machine Learning, Reinforcement Learning, Introduction to Deep Learning, Neural Networks
Math	Real Analysis, Stochastic Process, Linear Algebra, Numerical Analysis

ACADEMIC SERVICE

Journal Review

· IEEE Transactions on Automatic Control, IEEE Transactions on Systems, Man and Cybernetics: Systems, IEEE Control Systems Letters, IEEE Open Journal of Control Systems, IET Cyber-Systems and Robotics, International Journal of Aerospace Enginering, Scientific Report - Nature

Conference Review

· CDC 2017, ACC 2018, CDC 2018, ICCA 2018, CDC, 2019, ACC 2020, CDC 2020, ACC 2021, CDC 2021, MED 2021, CDC 2022, ICCA 2022, MECC 2022

TEACHING EXPERIENCE

EE 350 Continuous-Time Linear Systems August 2020 - May 2021
Teaching Assistant *University Park, PA*

· Instructed approximately 20 students weekly to solve recitation exercises and finish MATLAB assignments;
· Designed, proctored and graded monthly exams, held office hours and graded homework.

ME 355 Dynamic Systems Laboratory August 2015 - May 2016
Teaching Assistant *University Park, PA*

· Instructed over 50 students to finish 7 control experiments including robotic arms, magnetic force control and gyroscopes;
· Maintained 8 sets of laboratory apparatus and revised corresponding laboratory manuals.

WORK EXPERIENCES

TuSimple, Inc. January 2022 - Present
Software Engineer *San Diego, CA*

· Communicated with users and infrastructure providers, prepared product descriptions and created development plans;
· Developed computationally efficient services and pipelines, evaluated their computational cost and algorithmic accuracy;
· Deployed tested software in production environment, monitored their performance, troubleshot and fixed any issues.

Shanghai FANUC Robotics, Co., Ltd July 2014 - August 2014
Field Engineer Intern *Shanghai, China*

· Installed robot operation systems and programmed computer vision module of industrial robotic arms;
· Commissioned material handling robotic arms to finish a loading-inspecting-unloading procedure.

LEADERSHIP & SOCIAL SERVICES

Student Affairs Center, Shanghai Jiao Tong University April, 2011 - December, 2012
University Representative of National Student Loan Affairs *Shanghai, China*

· Supervised a team of over 30 members in organizing student loan signing ceremonies semesterly;
· Collaborated with bank representatives on verifying applicants' identities;
· Processed over 1600 student loan applications with a total value over RMB 10M (US$1.6M).

LANGUAGES

Chinese (native), English (professional proficiency)