Shijie Gao

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EDUCATION

Ph.D. in Computer Engineering *Aug.2017 – Aug. 2024*
University of Virginia, Charlottesville, VA
Advisor: Prof. Nicola Bezzo
Thesis: Transfer Learning Methods for Prediction, Replanning, and Adaptations of Autonomous Mobile Robots Under Degraded Conditions

M.E. in Computer Engineering *Aug.2017 – May. 2023*
University of Virginia, Charlottesville, VA

Exchange Student 4th year of Bachelor of Science in Automation *Aug.2016 – May. 2017*
University of California Berkeley, Berkeley, CA

Bachelor of Science in Automation *Aug. 2013 – July, 2017*
Beijing Institute of Technology, Beijing, China

WORK EXPERIENCE

Software Engineer II – Core Planner *Aug.2024 – Present*
DiDi Research America, Fremont, CA

- Conduct research and development of safe and efficient motion planning and control strategies for autonomous driving systems.

RESEARCH INTERESTS

The main objective of my research is to establish a foundation for **autonomous mobile systems** to **predict**, **detect**, **adapt**, and **recover against failures** and **changes** in **systems' dynamics** at **runtime** while ensuring **safety**. My research focuses on developing **learning-based control** and **safe planning** techniques, incorporating principles from machine learning, optimal control, adaptive planning, reachability analysis, and transfer learning.

My collaboration works extend into the areas of **robotic swarms**, cyber-physical systems (**CPS**) security, Human-robot interaction (**HRI**), and autonomous inspection, etc.,

RESEARCH EXPERIENCE

Autonomous Mobile Robots Lab *Charlottesville, VA*
Graduate Research Assistant *Jan. 2018 – Aug. 2024*

- Developed cutting-edge adaptive control and planning techniques that significantly enhance the safety and efficiency of autonomous robotic systems, effectively addressing critical challenges including state and uncertainty predictions, efficient path planning, optimal control, fault detection, and degradation recovery.
- Designed a novel physical testbed to characterize ground and ceiling effects for quadrotors, enhancing operational efficiency by up to 13% in energy savings and improving safety with a sensor-free, aerodynamics-based safe landing strategy.

- Designed and developed simulator software and a physical application for fully autonomous inspections using mobile robots, significantly advancing autonomous inspection technology by reducing the need for stable communication, extensive data post-processing, and data collection.
- Investigated swarm robotics cooperation strategies that enable efficient task relocation and completion in multi-robot systems, even amid communication, sensor, or actuator failures.
- Efficiently completed projects validating novel techniques, leading to the authorship of several papers that clearly communicate key concepts, published in prestigious robotics conferences and journals.

PUBLICATIONS

- **Peer reviewed Journals:**

  - **S. Gao**, E. Yel, N. Bezzo. *Meta-Learning-Based Proactive Online Planning for UAVs Under Degraded Conditions*. In IEEE Robotics and Automation Letters (RA-L), 2022 – Impact = 4.3
  DOI: 10.1109/LRA.2022.3191792

  - P. Bonczek, R. Peddi, **S. Gao**, N. Bezzo. *Detection of Nonrandom Sign-Based Behavior for Resilient Coordination of Robotic Swarms*. In Transactions on Robotics (TRO), 2022 – Impact = 7
  DOI: 10.1109/TRO.2021.3139592

- **Peer reviewed Journals under Review:**

  - **S. Gao**, N. Bezzo. *A Schwarz-Christoffel Mapping-based Framework for Sim-to-Real Transfer in Autonomous Robot Operations*. In Journal of Intelligent & Robotic Systems (JINT)

- **Peer reviewed Conferences:**

  - L. Bramblett, **S. Gao**, N. Bezzo. *Epistemic Prediction and Planning with Implicit Coordination for Multi-Robot Teams in Communication Restricted Environments*. In IEEE International Conference on Robotics and Automation (ICRA), London, UK, May 29 – June 2, 2023 – Acceptance Rate = 43%
  DOI: 10.1109/ICRA48891.2023.10161553

  - **S. Gao**, N. Bezzo. *A Conformal Mapping-based Framework for Robot-to-Robot and Sim-to-Real Transfer Learning*. In IEEE International Conference on Intelligent Robots and Systems (IROS), Prague, Czech Republic, Sept. 27 – Oct. 1, 2021 – Acceptance Rate = 45%
  DOI: 10.1109/IROS51168.2021.9636682

  - **S. Gao**, N. Bezzo. *Fast, Safe, and Proactive Runtime Planning and Control of Autonomous Ground Vehicles in Changing Environments*. In IEEE Systems and Information Engineering Design Symposium (SIEDS), Charlottesville, VA, April 29 –30, 2021
  DOI: 10.1109/SIEDS52267.2021.9483719

  - R. Peddi, C. Di Franco, **S. Gao**, N. Bezzo. *A Data-driven Framework for Proactive Intention-Aware Motion Planning of a Robot in a Human Environment*. In IEEE International Conference on Intelligent Robots and Systems (IROS), Las Vegas, NV, Oct. 25 – 29, 2020 – Acceptance Rate = 47%
  DOI: 10.1109/IROS45743.2020.9341210

  - P. Bonczek, **S. Gao**, N. Bezzo. *Model-based Randomness Monitor for Stealthy Sensor Attacks*. In American Control Conference (ACC), Denver, CO, July 1 – 3, 2020 – Acceptance Rate = 64%
  DOI: 10.23919/ACC45564.2020.9147412

  - D. Carter, M. Megan, **S. Gao**, C. Di Franco, N. Bezzo, D. Quinn. *Scaling Effects on Aerodynamic Interactions of rotorcraft around boundaries*. In APS Division of Fluid Dynamics, Seattle, WA, Nov. 23 – 26, 2019
  Bibcode: 2019APS..DFDB09004C

  - **S. Gao**, C. Di Franco, D. Carter, D. Quinn, N. Bezzo. *Exploiting Ground and Ceiling Effects on Autonomous UAV Motion*. In IEEE International Conference on Unmanned Aerial Systems (ICUAS), Atlanta, GA, June 11 – 14, 2019 – Acceptance Rate = 60%

DOI: 10.1109/ICUAS.2019.8798091

- **Peer reviewed Conferences under Review:**

  - **S. Gao**, L. Bramblett, N. Bezzo. *Take Your Best Shot: Sampling-Based Next-Best-View Planning for Autonomous Photography & Inspection.* In IEEE International Conference on Robotics and Automation (ICRA) 2025

- **Workshops:**

  - **S. Gao**, L. Bramblett, N. Bezzo. *Next-Best-View-based Task and Motion Planning for Autonomous Photography & Inspection*. In Workshop on Task and Motion Planning: from Theory to Practice within IEEE International Conference on Intelligent Robots and Systems (IROS), Detroit, MI, October 1-5, 2023

TEACHING EXPERIENCE

Graduate Teaching Assistant
University of Virginia, *Charlottesville, VA*

- SYS-6060/ECE-6501/CS-6501 "Autonomous Mobile Robots" *Fall '19'20'21'22'23*
  Grading & Lab Instructor for around 30 students for a graduate level robotic course

Graduate Mentor for Senior Undergraduate Capstone
University of Virginia, *Charlottesville, VA*

- 2021 System Design Capstone *Fall/Spring 2021*
  Co-mentored four undergraduate students on an autonomous robot navigation project
  DOI: 10.1109/SIEDS52267.2021.9483719
- 2020 System Design Capstone *Fall/Spring 2020*
  Co-mentored six undergraduate students on a quadrotor collision recovery project
  DOI: 10.1109/SIEDS49339.2020.9106654
- 2019 System Design Capstone *Fall/Spring 2019*
  Co-mentored seven undergraduate students on an autonomous agricultural robot project
  DOI: 10.1109/SIEDS.2019.8735598

TALKS

IEEE/RSJ International Conference on Intelligent Robots and Systems *2023*
Workshop Presentation - *Detroit, MI, USA*

IEEE/RSJ International Conference on Intelligent Robots and Systems *2022*
Contributed Paper Oral Presentation - *Kyoto, Japan*

IEEE/RSJ International Conference on Intelligent Robots and Systems, Presentation *2021*
Contributed Paper Oral Presentation - *Prague, Czech Republic*

IEEE International Conference on Unmanned Aircraft Systems, Presentation *2019*
Contributed Paper Oral Presentation - *Atlanta, GA, USA*

Link Lab Student Flash Talks *2019*
Presentation - *Charlottesville, VA, USA*

UVA Engineering Research Innovation Awards *2019*
Poster Presentation, Finalist - *Charlottesville, VA, USA*

UVA ECE Welcome back Research Poster Session *2018*
Poster Presentation, 2nd place Poster Award - *Charlottesville, VA, USA*

PROFESSIONAL ACTIVITIES

Journal Reviewers

IEEE Transactions on Robotics (T-RO)
IEEE Robotics and Automation Letters (RA-L)
IEEE Transactions on Cognitive and Developmental Systems (TCDS)
Journal of Intelligent & Robotics Systems (JINT)

Conference Reviewers

IEEE International Conference on Robotics and Automation (ICRA)
IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)
American Control Conference (ACC)
Mediterranean Conference on Control and Automation (MED)

SKILLS

Proficient in **C**++, MATLAB, Python, Robot Operating System (ROS1, ROS2), Gazebo, LINUX

Familiar with TensorFlow, PyTorch, Scikit-learn, OpenCV, Git, Docker

Proficient in Assembling, Developing, Operating and Maintaining a variety of robotic systems:

- UGV: Boston Dynamics Spot, Clearpath Jackal, Clearpath Ridgeback, Turtlebot 2/3/4, ROSBot, etc.,
- UAV: AscTec Hummingbird, AscTec Pelican, Crazyflie, DJI Matrice, DJI Mavi, Parrot Bebop, etc.,
- Sensors: RGB-D Camera, Thermal Camera, 2D/3D LiDAR, GPS etc.,
- Other platforms: Phidgets, DJI OSDK, Spot SDK, CasADi, Docker, Variety of Simulators, etc.,