WEIHANG GUO

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AREAS OF INTEREST

Task and Motion Planning, Graph Neural Network Theory, Robot Planning in Real, LLM/VLM in Robotics

EDUCATION

Rice University Houston, TX
M.S. in Computer Science · GPA: 4.0/4.0 *Aug. 2023 – Present*

Lehigh University Bethlehem, PA
B.S. Mathematics and Computer Science · 4 year Dean's list · GPA: 3.85/4.0 *Aug. 2019 – May 2023*

RESEARCH EXPERIENCE

Kavraki Lab · Rice University Houston, TX
Research Assistant, supervised by Dr. Lydia Kavraki and Dr. Zachary Kingston *Jan 2024 – Present*

- ❧ **LLM for Task and Motion Planning with Constraint Specifications:** Utilized GPT-4 to translate natural language into PDDL and Python scripts that support task constraints such as goal conditions, action ordering, and action blocking, providing users with more control over the sequence of solving long-horizon problems. [*C1.*]
- ❧ **Multi-Manipulator Motion Planning with Manifold-Constraints:** Proposed a new hybrid MRMP planning algorithm that schedules individual robots' paths, leading to a significant improvement in solve time compared to SOTA in constrained and shared workspaces.[*J1.*]

Prof. Rosa Zheng's Lab · Lehigh University Bethlehem, PA
Research Assistant, supervised by Dr. Rosa Zheng *Aug 2021 – May 2023*

- ❧ **Real World Head-to-Head Autonomous Racing:** Proposed and implemented an autonomous system that can detect opponent vehicles and switch between overtaking and optimal path; Utilized particle filter and Google Cartographer for localization and SLAM; Led a team to win 2nd place in the ICRA F1tenth 2022.
- ❧ **Underwater Object Detection:** Collected and augmented data on underwater left/right turn signs, and tuned a YOLO model to detect them; Deployed the model on Nvidia Jetson Nano.
- ❧ **A Comparison of Feature Descriptors for Visual SLAM in Underwater Environments:** Benchmarked seven feature descriptors for single-camera SLAM in a swimming pool and lake environment.
- ❧ **Underwater Acoustic Signal Processing and Analyzing:** Implemented and tuned the hyperparameters of a PRI filter and successfully detected all 21 fish tag acoustic signals from 20,000 false alarms. [*C2., P1.*]

PUBLICATIONS

Journal Articles

J1. **W. Guo**, Z. Kingston, K. Hang, and L.E. Kavraki, "Efficient Multi-Robot Motion Planning for Manifold-Constrained Manipulators by Randomized Scheduling and Informed Path Generation," (submitted to RA-L, preprint on arxiv.org/abs/2412.00366)

J2. **W. Guo**, B. Li, H. Zhou, C. Zhang, X. Wang, and C. Ni, "Construction and characterization of a bio-detector for inflammatory bowel disease," Chinese Journal of Biotechnology, vol. 34, no. 12, pp. 1906–1914, Dec. 2018, doi: https://doi.org/10.13345/j.cjb.180271.

Conference Papers

C1. **W. Guo**, Z. Kingston, L.E. Kavraki, "Task and Motion Planning using LLM and PDDL with Temporal Constraints," *2024 IEEE International conference on robotics and automation (ICRA). IEEE, 2024.*

C2. **W. Guo** and Y. R. Zheng, "Trade off Between the Probability of Detection and False Alarm Rate in Fish Tag Detection," *OCEANS 2022, Hampton Roads,* Hampton Roads, VA, USA, 2022, pp. 1-5, doi: 10.1109/OCEANS47191.2022.9977220.

Posters and Talks

P1. Trade off Between the Probability of Detection and False Alarm Rate in Fish Tag Detection. OCEANS 2022, Hampton Roads, VA, Oct 17-20, 2022

P2. Noninvasive Gut Inflammation Detector. iGEM 2017, Boston, MA, Nov 9-13, 2017

Selected Course Projects

Contrastive Learning on Image-Text Movie Dataset
Individual Project for COMP646: Deep Learn. for Vision and Lang., Rice University

Jan 2024 – May 2024

Instructed by Dr. Vicente Ordóñez

- ❧ Fine-tuned BERT and ResNet on the MM-IMDB dataset to classify movies into 27 genres using plots and posters.
- ❧ Implemented CLIP to learn text and image representation, achieving 87% accuracy with zero-shot classification.

Robotic Manipulation
Individual Projects for COMP562: Fundamentals of Robotic Manipulation, Rice University

Jan 2024 – May 2024

Instructed by Dr. Kaiyu Hang

- ❧ Sampled contact-based grasps using the friction cone, and optimized their qualities with reachability constraints.
- ❧ Implemented the online particle filter and autonomous exploration to estimate the base pose of a robot arm.

Ricci Flow Simulation in 2D
Individual Project for MATH331: Diff. Geo. of Curves & Surfaces, Lehigh University

Aug 2022 – Dec 2022

Instructed by Dr. Huaidong Cao

- ❧ Proved 2D Ricci flow solutions on compact surfaces always converge to constant curvature metrics.
- ❧ Visualized the 2D Ricci flow evolution over time with singularities and boundaries in Matlab.

Accelerated Computing using GPUs
Individual Project for ECE303: Accelerated Computing, Lehigh University

Aug 2021 – Dec 2021

Instructed by Dr. Rosa Zheng

- ❧ Implemented and benchmarked N-body problem simulations in C++ using serial, OpenACC, and CUDA, achieving a 30x speedup with CUDA over serial.

Coursework and Skills

Robotics: Robotic Manipulation, Autonomous Driving and Robotic Racing, IoT
AI/ML: Computer Vision, Reinforcement Learning, Deep Learning, Accelerated Computing, NLP
Mathematics: Multivariable Calculus, Graph Theory, Linear/Abstract Algebra, Real Analysis, Partial Differential Equations, Geometry, Differential Geometry, Game Theory, Theory of Probability
Computer Science: Data Structure, Computer Architecture, Software Engineering, Programming Language
Skills: Python, C/C++, PyTorch, OpenCV, TensorFlow, HuggingFace, Git/Github, ROS, Linux

Honors, Awards, and Certifications

Jason Chahin Innovation Scholar, Rice University	*Feb 2025*
Donald J. Hillman Memorial Award in AI, Lehigh University	*Apr 2023*
Recognition for Outstanding Academic Achievement, Lehigh University	*Aug 2022*
Blue Robotics Special Awards, Robosub 2022	*Aug 2022*
2nd place on 10th F1TENTH Autonomous Grand Prix, ICRA 2022	*Jul 2022*
Mountaintop Research Fellowship, Lehigh University	*May 2022*
Silver Medal, S.T. Yau Science Award in Biology	*Dec 2018*
Golden Medal and 4 Nominations, iGEM 2017	*Nov 2017*

Teaching Experience

Algorithmic Robotics (COMP 550), Teaching Assistant, Rice University	*Fall 2024*
Internet of Things (ECE 350), Teaching Assistant, Lehigh University	*Spring 2023*
Computer Vision (CSE 398/498), Teaching Assistant, Lehigh University	*Fall 2022*
Autonomous Driving and Robotic Racing (ENGR 010), Head Teaching Assistant, Lehigh University	*Fall 2022*

Other Experience

ICRA 2025 Reviewer	*Oct 2024*
Volunteered at Lehigh University Robot Versatility Workshop, 2022	*Jul 2022*
Team Leader of PL400 (Lehigh Autonomous Racing Team)	*Apr 2022*
Co-founder and Software Team Leader of Lehigh Underwater Robotics	*May 2021*
Founder of SHSBNU Synthetic Biology Club	*Sep 2017*