

Ziang Liu

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EDUCATION

Stanford University

- M.S. in Computer Science

Sep 2021 - Jun 2023 (Expected)

University of Southern California - Major GPA: 3.98/4.00

- B.S. in Computer Science

- B.S. in Applied and Computational Mathematics

Aug 2017 – May 2021

PUBLICATIONS

- H. Nemlekar*, **Z. Liu***, S. Kothawade, S. Niyaz, B. Raghavan and S. Nikolaidis, “Robotic Lime Picking by Considering Leaves as Permeable Obstacles”, To appear in 2021 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2021)
- H. Zhang, M. Yao, **Z. Liu**, J. Li, L. Terr, S. Chan, T. K. S. Kumar, S. Koenig, “A Hierarchical Approach to Multi-Agent Path Finding”, To appear in ICAPS 2021 Hierarchical Planning Workshop
- H. Zhang, M. Yao, **Z. Liu**, J. Li, L. Terr, S. Chan, T. K. S. Kumar, S. Koenig, “A Hierarchical Approach to Multi-Agent Path Finding”, To appear in SOCS 2021
- E. Heiden, **Z. Liu**, R. K. Ramachandran and G. S. Sukhatme, "Physics-based Simulation of Continuous-Wave LIDAR for Localization, Calibration and Tracking," 2020 IEEE International Conference on Robotics and Automation (ICRA), Paris, France, 2020, pp. 2595-2601, doi: 10.1109/ICRA40945.2020.9197138

PROJECTS

Autonomous Car Drifting USC DRCL - Professor Quan Nguyen

Oct 2020 – Present

- Optimized car trajectory in constrained time frame using dynamic/kinematic limits and collision as constraints in non-linear optimization problem
- Added Hokuyo LiDAR simulator and used hector_mapping for localization without odometry information, and feed estimated pose to MPC
- Integrated multi-threading with OpenMP in C++ to allow simultaneous control sequence execution and online nonlinear MPC solving with IPOpt

Robot Lime Picking using Cost-Based RRTs USC ICAROS Lab - Professor Stefanos Nikolaidis

Jun 2020 – Present

- Proposed new variant of RRT planner using Artificial Potential Field (APF) method to reduce original algorithm’s randomness while escaping local minima
- Formulated lime tree leaves and stems as penetrable obstacles and employed cost-based RRT to avoid unnecessary detours
- Applied and tested our method using robot arm both in simulation and with real JACO arm
- Research paper in progress

Hierarchical Multi-Agent Path Finding USC IDM Lab - Professor Sven Koenig

Jun 2020 – Present

- Proposed new framework to spatially partition a large MAPF instance into multiple smaller instances to boost scalability of existing MAPF solvers
- Integrated ILP solver that formulates MAPF problem as multi-commodity network flow problem, using capacity constraints to reduce agent clustering
- High-level solver finds paths that navigate agents through regions; Regional solver plans for agents inside its region
- Substantially increased framework scalability compared to other solvers on various common benchmark maps with solution quality close to a sub-optimal solver
- Potentially extendable to achieve completeness while maintaining scalability
- Research paper submitted and under review

Optimizing Tasks and Contacts for Robot Manipulation USC RESL - Professor Gaurav S. Sukhatme

Apr 2019 – Jun 2020

- Coordinated high-level symbolic planning with low-level motion planner to solve complex contact planning problems
- Formulated symbolic planning graph and STRIPS reasoning problems as a smooth optimization problem solvable with gradient-based optimizers

- Integrated Contact-Invariant Optimization that considered contacts as continuous variables and extended CIO to optimizing contacts with multiple objects
- Incorporated ReverseDiff.jl to more than double gradient computation speed with SNOPT7.jl as non-linear optimizer
- Setup URDFs and geometry prototypes for fast signed distance field computation used in contact point projection

Physics-based LiDAR Simulation *USC RESL - Professor Gaurav S. Sukhatme* *Apr 2019 – Sep 2019*

- Accomplished accurate LiDAR simulation in differentiable framework that supports gradient-based algorithms
- Modeled light-surface interaction and continuous wave sampling process, and many other physical phenomena
- Implemented ray tracing algorithm and laser beam divergence to increase model accuracy
- Designed and implemented experiments to collect real-world data from Hokuyo Laser Scanner
- Built automated laser scanner point cloud and pose data collecting and cleaning tool using C++ and RobotOS
- Constructed 2-D Localization of LiDAR using point clouds with SLAM-gmapping and Iterative Closest Point algorithm
- Setup and calibrated VICON system to track LiDAR and objects as ground truth for localization

Motion Planning Benchmark *USC RESL - Professor Gaurav S. Sukhatme* *Jan 2019 – May 2019*

- Compared performance of 20 motion planners across 4 path smoothing methods using MovingAI benchmarks
- Utilized C++ and Open Motion Planning Library to parse benchmark maps and scenes
- Applied GJK algorithm and the Separating Axis Theorem for collision checks
- Built web page hosted on GitHub Pages using HTML5 and JavaScript to visualize benchmark results
- <https://robot-motion.github.io/mpb/index.html>

TEACHING

USC Computer Science Department – Course Producer *Jan 2019 – Dec 2020*

- Courses
 - CSCI 360 - Introduction to Artificial Intelligence
 - Spring 2020, Fall 2020
 - CSCI 270 - Algorithms and Theory of Computing
 - Summer 2020
 - CSCI 170 - Discrete Methods in Computer Science
 - Spring 2019, Summer 2019, Spring 2020, Fall 2020
 - CSCI 104 - Data Structures and Object-Oriented Design
 - Fall 2019
- Tutored students during office hours and answered student questions on course forum
- Collaborated with professors to proofread and correct solutions to assignments
- Helped students with code debugging and assignment grading

AWARDS

USC Undergraduate Research Associates Program *Fall 2020*

- Received research funding to work with Professor Stefanos Nikolaidis at ICAROS Lab

ICPC SoCal Regional Contest *Fall 2019*

- Team placed in top 20 out of 90 teams

USC Programming Contest *Fall 2019*

- Ranked 4th among all participants, and 3rd among undergraduate students

SKILLS

Programming: C++, Julia, Python, Java, Matlab, R, HTML5, CSS, JavaScript

Tools: ROS, Git, Amazon SNS, S3, AWS API Gateway, AWS Elastic Beanstalk, Eclipse, Xcode, Docker

Operating Systems: Linux (Ubuntu), Windows, MacOS

ACTIVITIES

California Naturalist *Jan 2018 – Apr 2018*

- Engaged in volunteer research on natural coastal resources in California
- Participated in birdwatching walks regularly at Malibu Lagoon
- Awarded California Naturalist Certificate