

Zirui Li

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EDUCATION

University of Rochester

Bachelor of Science in Electrical and Computer Engineering, Minor in Computer Science

Rochester, NY

Expected May 2025

- **Cumulative GPA:** 3.96/4.00, **Major GPA:** 4.00/4.00
- **Relevant Courses**
 - **Mathematics:** Multidimensional Calculus; Linear Algebra; Differential Equations; Discrete Mathematics
 - **Computer Science:** Data Structure & Algorithm; C/C++ Programming; Machine Learning
 - **Computer Engineering:** Logic Design; Mechatronics and Embedded Systems; Electronic Devices & Circuits; Signals; Mobile Robot Estimation, Mapping and Interaction
- **Honors:** Member of Tau Beta Pi - The Engineering Honor Society

RESEARCH EXPERIENCES

Updating Robot Safety Representations Online from Natural Language Feedback

Rochester, NY

Supervisors: Prof. Somil Bansal, Dept. of Aeronautics and Astronautics, Stanford University; Prof. Andrea Bajcsy, Robotics Institute, CMU

May 2024 – Sep 2024

- Aimed to use human language feedback coupled with the robot's high-dimensional observations to update the robot's representation of safety constraints
- Selected and utilized the OWLv2 vision-language model (VLM) for interpreting natural language prompts and accurately identifying safety constraints, following empirical evaluations of multiple VLMs
- Implemented a Model Predictive Path Integral (MPPI) planner to guide the robot toward its goals efficiently
- Integrated a Hamilton-Jacobi reachability safety controller that updates online to guarantee the robot's safety from detected constraints
- Evaluated the robot's performance both quantitatively and qualitatively through simulation experiments
- Contributed to the final paper Updating Robot Safety Representations Online from Natural Language Feedback, which was accepted to ICRA 2025

Monocular Real-time Perception Package for Autonomous Driving

Rochester, NY

Supervisor: Prof. Tony Geng, Dept. of ECE, University of Rochester

Mar 2023 – Jul 2023

- Aimed to develop an integrated model addressing crucial tasks for autonomous driving, including object tracking, trajectory prediction, depth estimation, and road segmentation
- Successfully implemented a camera motion compensator for object tracking based on BYTE track, achieving state-of-the-art MOTA and IDF1 results on the MOT17 dataset
- Established an encoder-decoder framework for road segmentation, demonstrating top-tier performance with the highest mIOU value on the Cityscape dataset
- Efficiently connected tasks to a shared transformer backbone, resulting in a model operating at 29 FPS—555% faster than counterparts using mapping techniques for similar tasks
- Authored a paper titled No Map Needed: Monocular Real-time Perception Package for Autonomous Driving

PUBLICATION

- Santos, L., Li, Z., Peters, L., Bansal, S., & Bajcsy, A. Updating robot safety representations online from natural language feedback. Accepted by ICRA 2025. (arXiv: <https://arxiv.org/abs/2409.14580v1>)

COURSE PROJECTS

Ink to LaTeX

Rochester, NY

Supervisor: Prof. Zhiyao Duan, Dept. of ECE, University of Rochester

Mar 2024 – May 2024

- Led a four-student team that designed and implemented a two-stage pipeline for handwritten math formula recognition and conversion to LaTeX code
- Investigated the quality and useability of several datasets from the internet and organized one of them to COCO format for use
- Trained a YOLOv8 model to achieve over 99% precision in recognizing handwritten math symbols
- Developed and trained a custom transformer-based model for LaTeX sequence generation, incorporating token embedding and positional encoding for enhanced spatial understanding
- Presented the project and results during a publicly accessible class session

Mobile Robot Mapping, Estimation, and Interaction

Rochester, NY

Supervisor: Prof. Thomas Howard, Dept. of ECE, University of Rochester

Jan 2024 – Apr 2024

- Developed perception, localization, and navigation modules in ROS with C++ that enable the robot to dynamically choose and navigate to waypoints in partially known environments
- Implemented Extended Kalman Filter localization, occupancy grid mapping, input space sampling path planning and obstacle avoidance algorithm
- Tuned the program on a self-built simulator and GUI to ensure its functionality
- Tested the program on TurtleBot2 to ensure its robustness in the real world

PID Controller

Rochester, NY

Supervisor: Prof. Thomas Howard, Dept. of ECE, University of Rochester

Nov 2023 - Dec 2023

- Developed a proportional-integral-derivative controller using C to precisely regulate the rotation of a gear motor to a specified angle
- Implemented the controller on an Explore 16/32 board, seamlessly interfacing with MATLAB through UART to receive and act upon target angle information
- Utilized PWM signals through an H-bridge to effectively control both the direction and rotation speed of the gear motor, achieving a final steady-state error within the range of $\pm 0.5^\circ$

MIPS Emulator

Rochester, NY

Supervisor: Prof. Tony Geng, Dept. of ECE, University of Rochester

Feb 2023 – Mar 2023

- Developed an emulator in C that aims to fetch and execute the binary MIPS instructions
- Built upon an existing register memory system, implement 60 MIPS instructions
- Constructed a loop with a program counter that keeps fetching the correct instruction
- Gained a deep understanding of how instructions and data are processed and passed around the registers, the arithmetic logic unit, and the memory

TEACHING EXPERIENCE

Mechatronics and Embedded Systems

Rochester, NY

Teaching Assistant

Sept 2024 – Dec 2024

- Led lab sessions and held office hours that guided students through lab coding assignments by explaining the underlying ideas and teaching them how to look up different datasheets
- Prepared and validated lab equipment such as development boards, encoders, and H-bridges
- Graded lab code, reports and exams, debugged and found out where the code went wrong, providing debug suggestions for students

Discrete Mathematics

Rochester, NY

Teaching Assistant

Aug 2022 – Dec 2022

- Provided both online and face-to-face office hours to ensure students received necessary assistance.
- Delivered timely feedback to students by grading over 100 assignments or exams weekly
- Summarized and reported students' feedback to the professor

WORKING EXPERIENCE

NR Electric

Nanjing, China

Embedded System Engineering Intern

Jul 2022 – Aug 2022

- Responsible for developing a Delayed Fluorescence-based thermometer as an embedded system engineer intern in the engineering team
- Acquired the theoretical foundation of the Thermometer through extensive literature review and discussions with R&D colleagues
- Designed and programmed C-based software that interfaces with an optical sensor, applied noise reduction techniques to optical data, and converted the data to temperature values
- Achieved the performance with just a $\pm 2^\circ\text{C}$ error, exceeding the requirement

SKILLS

- **Programming Languages:** C/C++, Python, ROS, Java, MATLAB, MIPS assembly, Verilog
- **Software:** Rhino, Blender