Ruoqu Chen

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Education

Tsinghua University *Sept 2022 – Now*
Department of Automation

- Overall GPA: 3.83/4.0
- Senior GPA: 3.91/4.0
- TOEFL: 102
- **Coursework:** Computer Languages and Programming (4.0), Advanced Python Programming (4.0), Signal and System (4.0), Digital Electronics (4.0), Discrete Mathematics (4.0), Introduction to Deep Learning

Experience

Research Assistant *IRM-Lab, Tsinghua University*
Planning and Control for Carotid Artery Ultrasound Robots in Clinical Dynamic Environments *Dec 2023 – Dec 2024*

- Utilized point cloud camera for body tracking and detecting obstacles for motion planning. Applied RRT* algorithm for motion planning and obstacle avoidance using the Franka robotic arm.
- Developed communication pipelines between the simulation and the physical robot, enabling smooth execution of planned motions. Implemented impedance control to follow joint and cartesian trajectories.
- Integrated human intention recognition for various situations, including human-intended guidance and obstacle avoidance with stable end-effector contact, tested on multiple volunteers.
- The planning achieved a success rate of over 90% while maintaining an average computation time around 1.2s.

Research Assistant *Robot Control Lab, Tsinghua University*
Whole-Body Model Predictive Control for Mobile Manipulation with Task Priority Transition *July 2024 – Sep 2024*

- Developed a Whole-Body Model Predictive Control (WBMPC) framework to manage task priorities and scheduling in multi-task mobile manipulation scenarios. Integrated task priorities into a unified weight matrix, enabling smooth transitions across tasks in both spatial and temporal dimensions.
- Conducted simulation and real-world experiments to validate the framework, demonstrating improved task execution fluidity and responsiveness compared to baseline methods.
- This work has been submitted to **ICRA 2025** , where I am listed second author. To the best of our knowledge, this work represents one of **the first successful** implementations of **a non-holonomic mobile manipulator opening and traversing through self-closing doors** in real-world conditions.

Research Assistant *Robot Control Lab, Tsinghua University*
Reinforcement Learning-Based Humanoid Robot Running Optimization *Sep 2024 – Present*

- Trained the Booster-T1 humanoid robot for standing, walking, and running using RMA and PPO algorithms in the IsaacGym simulation environment, designing reward and penalty functions based on human movement patterns.
- Exploring the integration of physical principles into the robot's locomotion control, aiming to enhance the robot's running efficiency and natural movement patterns.
- Verified the robot's performance in the Mujoco environment, achieving a running speed exceeding 1.5 m/s and stable omnidirectional walking motions in simulation.

Short-term Visiting Student *Innowing Center, Hongkong University*
Utilizing AprilTags' 6-DOF Pose for Robotic Arm Manipulation *July 2024*

- Designed a calibration-free framework to control the end-effector pose of a robotic arm using Apriltags.

- Utilized a Realsense camera to detect Apriltags and computed relative pose transformations through coordinate frame calculations. Successfully tested the framework on the Aloha, demonstrating precise and reliable pose adjustments.

Publications

Whole-Body Model Predictive Control for Mobile Manipulation with Task Priority Transition Submitted to ICRA 2025

Yushi Wang, ***Ruoqu Chen***, Mingguo Zhao

Our Website

Projects

A Path Planning Visualization Tool that includes a companion Franka Robot Controller for Receiving and Executing Trajectories *github repo*

- A path planning visualization tool with state-of-the-art planning algorithms for robot arm planning.
- Companion Franka joint position/impedance controller for receiving trajectories.
- Able to plan and follow joint-trajectories smoothly while avoiding obstacles, with over 90% success rate and 0.6s computing cost.

Food Classification Convolutional Neural Network *Dec 2024*

- Constructed and trained AlexNet, ResNet and a custom CNN model for the classification of 10 types of common foods. Applied data augmentation techniques (random rotation, flipping, and cropping) to improve model generalization and reduce overfitting. Demonstrated a 20% reduction in model overfitting by employing dropout, early stopping and data augmentation techniques.
- The custom CNN model achieved similar classification accuracy to ResNet on the same dataset, demonstrating its efficiency.

Apriltag 6-Dof pos end-effector controller *July 2024*

- A framework for controlling end-effector of robotic arms using a Realsense camera detecting apriltags.
- Allowing the end-effector to follow the movement of the cube, while not relying on calibration.

Vision-based Robot Dog soccer player *2023*

- Designed a state machine controller for a real-world four-legged robot dog to play 2v2 football, incorporating ball tracking using OpenCV algorithms.
- Won 2nd prize in the competition, with the robot successfully tracking, kicking the ball, and guarding the goal.

Technical Skills

Robotics Tools: ROS, ROS2, Moveit, IssacGym, Gazebo

Deep Learning Skills: Pytorch, Familiar with Machine Learning and Deep Learning, including several Deep Learning Frameworks. Familiar with Linux.

Developement Languages: Skilled at C++, C, Python, Matlab; Familiar with Verilog HDL, Keil, Multisim, LTSpice

Awards

Overall Excellence Award (10%): Department of Automation, Tsinghua University, 2024

Sports Excellence Award: Tsinghua University, 2023
Champion, Women's Orienteering, Short Distance Event, Tsinghua University, 2024
Champion, Orienteering Team Event, Beijing Capital University Sports Games, 2024

Social Work Excellence Award: Tsinghua University, 2023

Tsinghua University Friends – Zhou Huiqi Scholarship: Tsinghua University, 2023, 2024

Honorable Mention (H Award), American Mathematical Modeling Contest (MCM): 2023

Second Prize, Senior Group (NOIP): National Olympiad in Informatics in Provinces, 2018