Qianwei(Robin) Wang

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EDUCATION

B.S. Computer Science,University of Michigan-Ann Arbor,MI Sep.2023-May.2026
GPA:3.94/4.0
B.Eng Electrical Information Engineering,Xidian University,China Sep.2021-Jul.2023
GPA:3.90/4.0

SKILLS

Programming: C/C++, Python, Matlab
Tools: ROS, PyTorch,OpenCV, Eigen, Ceres

EXPERIENCE

Undergraduate Research Assistant,LIVE,University of Michigan Sep.2023-now
Advisor: Dr.Vineet R.Kamat

Undergraduate Research Assistant,ARM,University of Michigan May.2024-Aug.2024
Advisor: Dr.Dmitry Berenson

PUBLICATION

①**Wang,Qianwei**;Xu, Yifan;Kamat, Vineet; Menassa,Carol."OVAMOS: A Framework for Open-Vocabulary Multi-Object Search in Unknown Environments" (in preparation)

②Xu, Yifan; **Wang, Qianwei**; Lillie, Jordan; Kamat, Vineet; Menassa,Carol."CoNav Chair: Design of a ROS-based Smart Wheelchair for Shared Control Navigation in the Built Environment"
(submitted to **ISARC**)

③Xu, Yifan;Luo, Ziming*;**Wang, Qianwei***; Kamat, Vineet; Menassa, Carol."Point2Graph: An End-to-end Point Cloud-based 3D Open-Vocabulary Scene Graph for Robot Navigation."
(submitted to **ICRA**)

④Xu, Yifan; **Wang, Qianwei**; Kamat, Vineet; Menassa, Carol."Socially-Aware Shared Control Navigation for Assistive Mobile Robots in the Built Environment."
(submitted to **Journal of Computing in Civil Engineering**)

⑤Xu, Yifan; **Wang, Qianwei**; Kamat, Vineet; Menassa, Carol. "A Shared Autonomy base Wheelchair Navigation Stack considering User Preference and Control." *ASCE International Conference on Computing in Civil Engineering* ,2024
(accepted)

SLECTED PROJECTS

Open-Vocabulary Multi-Object Search in Unknown Environments①

Supervised by Dr.Vineet R.Kamat,LIVE,University of Michigan Nov.2024-now

I am working on enabling the robot to simultaneously build beliefs about **multiple types of objects while exploring the environment**. By integrating **POMDP** (Partially Observable Markov Decision Process) with **Vision-Language Models** (VLMs), I aim to **optimize both the search path and the sequence** of target object searches effectively.

Socially-Aware and Shared Autonomy-based Wheelchair②④⑤

Supervised by Dr.Vineet R.Kamat,LIVE,University of Michigan Sep.2023-now

We have designed a navigation framework for wheelchairs that integrates **user preferences** into both the local planner and the global planner. In addition to basic obstacle avoidance capabilities, we developed a **SS (Socially Aware)-MPC-DCBF (Dynamic Control Barrier Function)** framework to enable the wheelchair to effectively and safely **avoid dynamic pedestrians.**

My contribution:

☺I utilized Gazebo to **establish a simulation environment** and **built an experimental platform** on a wheelchair equipped with a LiDAR, camera, IMU, and CAN communication system in real-world settings. Additionally,I **implemented state-of-the-art odometry and mapping algorithms**, such as FASTER-LIO, LEGO-LOAM, and RTAB-Mapping, to evaluate and enhance the system's performance in both simulated and real-world environments.

☺In the physical-world experiments of our research, I was responsible for transferring the algorithms from the simulation environment to the real robot. This process included using **PID** control to compensate for errors in the wheelchair's actual motion and fine-tuning the parameters of the **MPC-based local planner**.

Tool Retrieval in Agricultural Environments

Supervised by Dr.Dmitry Berenson,ARM,University of Michigan May.2024-Aug.2024

This project aimed to enable the Spot robot to operate in **outdoor** agricultural environments by responding to human instructions. The robot was designed to navigate to the vicinity of the specified tool, identify the target tool from a **cluttered set of tools** in an **open-vocabulary** setting, and perform the pick-up and subsequent delivery to the user's hand.

My contribution:

During the experiments, I identified that the current open-vocabulary detector performed poorly in scenarios involving **long distances or objects in cluttered environments**. To address these challenges:

☺For long-distance detection, I adopted a strategy inspired by VLFM (Vision-Language Frontier Map), leveraging the scene reasoning capabilities of Vision-Language Models (VLMs) to guide the robot to regions where the target object was likely to be located.

☺For object-in-clutter scenarios, I designed a solution combining **a real-time detector (YOLO-World) with a dynamic scanning** approach, enabling the robot to collect **multiple viewpoints** and improve detection accuracy.

3D Open-Vocabulary Scene Graph for Robot Navigation③

Supervised by Dr.Vineet R.Kamat,LIVE,University of Michigan Mar.2024-Sep.2024

We developed Point2Graph, a point cloud-based 3D open-vocabulary scene graph framework for robot navigation that **eliminates reliance on RGB-D images** while integrating room and object detection with open-vocabulary classification.

My contribution:

☺My contribution lies in identifying the limitations of learning-based room segmentation methods in complex real-world scenarios. To address this, I incorporated room boundary information derived from further processing point cloud data, which was then used for denoising the final scene density map, achieving improved segmentation performance.

Improved Personal Space Model for Robot Socially-aware Navigation

Final Project of ROB498 (HRI) by Christoforos Mavrogiannis,University of Michigan, Sep.2023-Dec.2023

☺Combining velocity-based personal space and density-based personal space from past papers through weighting, and after testing, it achieved superior performance in terms of safety and efficiency in the actual navigation process.

☺By incorporating the distance to personal space and the distance to the target point as two factors, a cost function is constructed and applied to the Model Predictive Control (**MPC**), selecting the optimal path as the robot's route.

Code:https://github.com/weiqianwang123/Group_based_navigation_v1

Detection and Motion State Estimation for Fast Rotating and Translating Targets

University Championship-RoboMaster (held by DJI) Sep.2022-Aug.2023

☺Use **OpenCV** for real-time processing of images from high-speed industrial cameras, detect objects in the field of view that are moving and rotating quickly, with a detection frame rate exceeding 100FPS.

☺The detected target is transformed into an absolute coordinate system using the **PnP** algorithm, and the absolute coordinates are fed into a state estimator centered around the Extended Kalman Filter (**EKF**). Simultaneously with state estimation, a **3D SORT tracker** is also employed to ensure continuous tracking of a target and obtaining its motion state.

Code:https://github.com/weiqianwang123/RMOS_2023

AWARDS

First Prize in The Chinese Mathematics Competitions

Second Prize in University Championship-RoboMaster (held by DJI)-RMUC

Second-class Scholarship at the Xidian University