Runxuan (Jerry) Wang

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EDUCATION

University of Pennsylvania **Philadelphia, Pennsylvania**
Master of Science in Engineering, Robotics *Aug 2024 - May 2026*

University of Illinois Urbana Champaign **Urbana, Illinois**
Bachelor of Science in Computer Engineering *Aug 2020 - May 2024*

TECHNICAL SKILLS

Programming: Python, C, C++, MATLAB, x86 Assembly, SystemVerilog
Libraries and Tools: Robot Operating System (ROS), PyTorch, KiCAD, RTOS, Git, GDB, OpenOCD
Other Skills: Computer Aided Design (CAD), 3D Printing, PCB Design, FPGA Design

PUBLICATIONS

Sim-to-Real Adaptation with Graph-Based Neural Dynamics for Granular Object Manipulation **Under Review**
Kaiwen Hong, Haonan Chen, **Runxuan Wang***, Kaylan Wang*, Mingtong Zhang, Shuijing Liu, Yunzhu Li, and Katherine Driggs-Campbell*

DRAGON:A Dialogue-Based Robot for Assistive Navigation with Visual Language Grounding **Published**
*Shuijing Liu, Aamir Hasan, Kaiwen Hong, **Runxuan Wang**, Peixin Chang, Zachery Mizrachi, Justin Lin, D. Livingston McPherson, Wendy A. Rogers, and Katherine Driggs-Campbell*
IEEE Robotics and Automation Letters (RA-L), 2024
Website Paper Videos Code

EXPERIENCES

Robotic Perception, Interaction, and Learning Lab (RoboPIL) **University of Illinois Urbana Champaign**
Undergraduate Research Assistant, advised by Prof. Yunzhu Li *June 2023 - July 2024*

- Developed a **sim-to-real framework** on a Kinova Gen3 robotic arm for **long-horizon granular object manipulation**, leveraging a **Graph Neural Network (GNN)-based dynamics model** trained in simulation and adapted to real-world scenarios.
- Designed **parameterized behavior primitives** for efficient granular object manipulation, forming a skill library that enables a **Monte Carlo Tree Search (MCTS)**-based planner to empty filled containers completely.
- Developed a **perception pipeline** that processes RGB-D data from four OAK-D Pro Cameras, using **colored-ICP** to accurately align pre-scanned container meshes with real-world point clouds.
- Performed **approximate convex decomposition** on container and tool meshes to enhance physical environment accuracy in Issac Gym, minimizing the sim-to-real gap between simulated and real-world data.
- Evaluated the system extensively on long-horizon scooping tasks in **real-world environments**, where the approach demonstrated **strong generalization capabilities** across a wide range of granular objects.
- Designed and implemented both hardware and software components for a **16-DOF robotic hand teleoperation system**, optimizing data collection for dexterous manipulation tasks, with potential applications in imitation learning.

Human-Centered Autonomy Lab (HCA Lab) **University of Illinois Urbana Champaign**
Undergraduate Research Assistant, advised by Prof. Katie Driggs-Campbell *May 2022 - May 2023*

- Developed a **dialogue-based wayfinding robot** for assisting visually impaired users in navigating complex indoor environments using **open-vocabulary** voice commands, with **real-time** performance on an NVIDIA Jetson Nano.
- Fine-tuned a **Contrastive Language-Image Pre-training (CLIP)** model with a custom dataset to interpret **free-form commands** and overcome camera limitations such as low mounting angles, achieving **100% success** in **landmark recognition** during real-world trials.
- Conducted extensive user studies, demonstrating a **32% improvement** in overall user experience compared to baseline navigation methods. Participants consistently reported enhanced system responsiveness, accurate intent recognition, and more intuitive dialogue-based interaction.
- Implemented a human pose-estimation system using a D435i depth camera based on the TensorFlow BodyPix model, enabling accurate motion tracking.

Illini RoboMaster Robotics Team **Urbana, Illinois**
Embedded Systems Team Lead ***Code*** *Aug 2021 - Aug 2023*

- Established a **teleoperation framework** for manipulating a **6-DOF robot arm** with gravity compensation, enabling precise and intuitive control of the end effector.
- Developed and maintained robust motor drivers utilizing **CAN** and **RS485** protocols with the **STM32 HAL** library, integral to the control of the robot's chassis and gimbal systems.
- Designed and implemented gimbal stabilization software across multiple robots using **feedforward PD control**.
- Mentored new team members on hands-on projects, facilitating their learning in communication protocols, feedback control algorithms, STM32 development, and git version control, fostering a collaborative and knowledge-rich team environment.
- Played a pivotal role in securing the 2nd place in the 2022 RoboMaster ICRA Challenge, and 3rd and 2nd place in the 2022 and 2023 RoboMaster University League Northern America rounds respectively.

Southern University of Science and Technology (SUSTech) **Shenzhen, China**
Robotics Intern *Jun 2021 - Aug 2021*

- Deployed a navigation system on a mobile ROS platform, integrating SLAM and image recognition algorithms for autonomous navigation.
- Contributed to the creation of SUSTech's autonomous vehicle dataset by labeling point cloud data to enhance perception accuracy.
- Supported SUSTech's inaugural Autonomous Driving Challenge by maintaining robots for competitors, ensuring smooth event execution.

PROJECTS

Autonomous "Sentry" Robot for RoboMaster Competition [Code] *ROS, Python, C++*

- Developed the complete software stack for an **autonomous omnidirectional robot** using **ROS** and **FreeRTOS**, enabling smooth navigation across environments with slopes and dynamic obstacles.
- Implemented a robust navigation system based on **FAST-LIO SLAM**, utilizing a **MID360 3D LiDAR** for precise mapping and localization.
- Engineered the embedded software for the robot, enabling low-latency communication between the **Jetson Orin** and **STM32** board via a **custom UART protocol**.

Wheeled-Legged Balancing Robot - Senior Design "Best Overall Project" [Code] *C, C++, MATLAB, KiCAD*

- Led the development of a versatile wheeled-legged balancing robot, capable of **balancing, load-carrying, and jumping**.
- Designed a custom development board based on the **STM32F103 MCU**, with support for **CAN, SPI, and UART communication**.
- Developed low-level drivers for device communication based on **STM32 HAL**, with task management implemented via **FreeRTOS**.
- Integrated the **Mahony Filter** for accurate state estimation from the **Inertial Measurement Unit (IMU)**.

'MentOS' Multi-terminal Operating System *C, x86 assembly*

- Developed a **multi-terminal operating system** from scratch, supporting up to 6 terminals with independent processes.
- Expanded the functionality of the system by integrating support for 10 essential system calls including **execute, halt, open, close, read and write**.
- Engineered **virtual memory management** through assignment of page tables and directories.
- Implemented a robust **file system** supporting data reads across multiple blocks, alongside creating intuitive APIs facilitating data retrieval based on file name and inode number.
- Integrated **round-robin scheduling** to permit concurrent execution of up to 6 programs across multiple terminals.

FPGA Double Player Street Fighter *C, System Verilog*

- Developed a dynamic 2-player crossover fighting game housed on a **system-on-chip on FPGA**, leveraging C and System Verilog.
- Integrated a NIOS II processor to facilitate seamless USB keyboard control and efficient management of On-Chip Memory and SDRAM.
- Enhanced the gaming experience by optimizing the storage of sprites and images, characterized by specific dimensions and color depth attributes.

AWARDS

Grainger Best Overall Project Award *(Fall 2023 Senior Design: Wheel-Legged Balancing Robot)*

2024 RoboMaster University Championship: **Third Prize**

2023 RoboMaster University League North America 1v1 Confrontation: **2nd Place (Top 10%)**

2023 RoboMaster University Championship: **Third Prize**

2022 RoboMaster University League North America 1v1 Confrontation: **2nd Place (Top 10%)**

2022 RoboMaster University League North America 3v3 Confrontation: **3rd Place (Top 15%)**

2022 RoboMaster ICRA Challenge: **2nd Place**