Runxuan (Jerry) Wang

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EDUCATION

University of Pennsylvania — **Philadelphia, Pennsylvania**
Master of Science in Engineering, Robotics — *May 2026*

University of Illinois Urbana Champaign — **Urbana, Illinois**
Bachelor of Science in Computer Engineering — *May 2024*

TECHNICAL SKILLS

Programming: Python, C/C++, SystemVerilog
Robotics & ML: ROS / ROS2, NVIDIA Isaac Lab & Isaac Sim, PyTorch, OpenCV
Embedded & Hardware: Linux, RTOS, Git, GDB, OpenOCD, KiCad, PCB Design, FPGA Design, CAD, 3D Printing

PUBLICATIONS

Gotta Scoop 'Em All: Sim-and-Real Co-Training of Graph-based Neural Dynamics for Long-Horizon Scooping
Kaiwen Hong, Haonan Chen, **Runxuan Wang***, Kaylan Wang*, Mingtong Zhang, Shuijing Liu, Yunzhu Li, and Katherine Driggs-Campbell*
Under Review

DRAGON:A Dialogue-Based Robot for Assistive Navigation with Visual Language Grounding
*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

Amazon Robotics, Innovation Lab — Westborough, Massachusetts
Applied Scientist Intern, advised by Taşkin Padır — *July 2025 - Dec 2025*

- Led **zero-shot sim-to-real deployment** of a dexterous policy onto **22-DOF hardware** (UR5e + LEAP Hand); integrating *FoundationPose* and *SAM2* for real-time 6D tracking and point-cloud perception to enable robust closed-loop control under real-world stochasticity.
- Developed a **hierarchical curriculum reinforcement learning** framework in *NVIDIA Isaac Lab* using **PPO**, achieving a **83% success rate** in manipulating out-of-distribution, non-convex geometries by progressively increasing task difficulty and environment complexity.
- Designed an **asymmetric teacher-student distillation pipeline** to address partial observability, transferring policies from a privileged teacher (full states and contact forces) to a deployment-ready student limited to onboard sensing.
- Engineered a high-fidelity **data collection system** using *Apple Vision Pro* and an **optimization-based motion retargeting solver**, enabling rapid expert demonstration collection for training and deploying an imitation learning policy on hardware.

Janus Intelligent Robots Lab (JIRL) — University of Pennsylvania
Research Assistant, advised by Antonio Loquercio — *August 2024 - June 2025*

- Developed a **zero-shot, long-horizon multi-target semantic navigation system** in Habitat Sim to address the *DARPA TIAMAT Challenge* task of locating required objects from high-level language prompts in minimal time.
- Designed a **hierarchical navigation strategy** that adaptively selects the next target based on **3D memory**, **scene observations**, and **semantic priors**, enabling efficient sequential object search and task completion.
- Integrated *BLIP-2* for **2D semantic value mapping**, combined *YOLO* and *GroundingDINO* for **multi-object detection and grounding**, and utilized *MobileSAM* for **segmentation-based 3D reconstruction**.
- Built a **3D spatial memory module** to dynamically store, query, and update segmented point clouds, enhancing **spatial reasoning** and **long-horizon consistency** across navigation episodes.

Robotic Perception, Interaction, and Learning Lab (RoboPIL) — University of Illinois Urbana Champaign
Undergraduate Research Assistant, advised by 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.
- Designed and implemented both hardware and software components for a **16-DOF robotic hand teleoperation system**, optimizing data collection for dexterous manipulation tasks.

Human-Centered Autonomy Lab (HCA Lab) — University of Illinois Urbana Champaign
Undergraduate Research Assistant, advised by 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 **body 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*

- Developed a leader–follower teleoperation framework for a custom-built **6-DOF robotic arm** with **gravity compensation**, implemented on an **STM32F4** microcontroller running **FreeRTOS**, enabling precise and intuitive end-effector control.
- Developed and maintained reliable motor driver firmware utilizing **CAN** and **RS485** protocols via the **STM32 HAL** library, ensuring robust control of the robot's chassis and gimbal systems.
- Designed and deployed **gimbal stabilization** algorithms across multiple robotic platforms using **feedforward PD control**, enhancing motion smoothness and orientation accuracy.
- 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.

PROJECTS

F1Tenth Autonomous Racing — ***Python, ROS2, JAX***

- Engineered a real-time **Model Predictive Path Integral (MPPI)** controller in ROS2, leveraging GPU-accelerated trajectory sampling on an NVIDIA Jetson Orin Nano to achieve optimal control at 50Hz+.
- Developed a dynamic perception stack using **LiDAR occupancy grid mapping** and **Euclidean clustering** to isolate and track opponent vehicles while filtering out static track boundaries.
- Optimized complex maneuvering capabilities by designing a specialized **parallel parking system** within the MPPI framework, achieving high-precision positioning in constrained environments through custom cost-function tuning.

Reinforcement Learning-based High-Speed Drone Racing [Code] — ***Python, PyTorch, NVIDIA Isaac Sim***

- Developed a **high-speed drone racing framework** in *OmniDrones* and *NVIDIA Isaac Sim*, implementing a **PPO-based reinforcement learning policy** capable of agile trajectory tracking, rapid gate traversal, and precise attitude control under high-speed dynamics.
- Designed **multi-objective reward functions** that jointly optimize **speed**, **flight stability**, and **gate traversal accuracy**, enabling stable end-to-end policy learning and consistent recovery from off-course or unstable flight conditions.
- Achieved a **40.7% success rate** and an average velocity of **7.94 m/s** on a 127 m racetrack, demonstrating strong **policy generalization** and robustness across **procedurally generated track layouts** and variable aerodynamic conditions.

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

- Developed the complete software stack for an **autonomous omnidirectional robot**, integrating **ROS** on an NVIDIA Orin Nano board and **FreeRTOS** on an STM32F4 board. Enabled smooth navigation across diverse environments, including slopes and dynamic obstacles.
- Implemented a robust navigation system based on **FAST-LIO SLAM**, utilizing a **MID360 3D LiDAR** for precise mapping and localization.
- Utilized the **PCL** library to process raw point clouds by estimating surface normals and applying filters based on gradient, height, and proximity to the robot to enhance path planning.
- 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 a **Mahony filter** to fuse accelerometer and gyroscope data for precise **attitude and orientation estimation** from the **IMU**.

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

- Developed a **multi-terminal operating system** from scratch, implementing a **round-robin scheduler** to support the concurrent execution of independent processes across up to 6 terminals.
- Engineered core kernel subsystems, including **virtual memory management** via page tables and a robust file system supporting multi-block data reads through inode-based APIs.
- Integrated **10 essential system calls**, such as execute, halt, and file I/O operations (open/read/write), to facilitate high-level hardware abstraction and process control.

AWARDS

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