

KAIXIN CHAI

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🏛️ MAIN EXPERIENCE

Korea Advanced Institute of Science and Technology | Visiting Student Dec. 2024 – Now

Whole-body Manipulation, Low-level Skills in Manipulation, and Teleoperation

City University of Hong Kong | Research Assistant Sep. 2023 – Jun. 2024

Mobile manipulation, manipulation based on foundation model, and wheel-legged robot control

Zhejiang University | Research Assistant Jun. 2022 – Sep. 2023

Perception-aware planning, SLAM, quadrotor control, and relevant commercialized R&D projects

Xi'an Jiaotong University | Bachelor in Energy and Power Engineering Sep. 2018 – Jun. 2022

Average grade: 91.25/100. Honorable class. Participated in multiple competitions and research projects

★ CURRENT FOCUS

Exploration and Online Adaptation of Manipulation Skills

While current manipulation policies, such as ACT and diffusion-based approaches, have demonstrated effectiveness in guiding low-level tasks, and recent advancements in Visual-Language-Action models (e.g., RT-2 and OpenVLA) show promising generalization capabilities through positive transfer, these powerful models remain highly data-intensive, requiring vast amounts of expert demonstrations. However, given the diversity in tasks, manipulated objects, and robot configurations, simply scaling up the training data may not be the silver bullet for achieving generalizable manipulation. My research focuses on developing effective approaches for robots to explore and acquire skills in real-world environments, with the ultimate goal of enabling robots to accomplish tasks through autonomous exploration, rather than relying on pre-trained skills for anticipated scenarios.

📄 PUBLICATION

[1] **Chai, K.**, Xu, L., Wang, Q., Xu, C., Yin, P. & Gao, F. (2024). LF-3PM: a LiDAR-based Framework for Perception-aware Planning with Perturbation-induced Metric. IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2024). STATUS: Accepted.

[2] Yang, T., **Chai, K.**, Xu, L. & Gao, F. (2024). Ground Effect-Aware Modeling and Control for Multicopters: Enhanced Precision and Energy Efficiency. IEEE/ASME Transactions on mechatronics (T-Mech). STATUS: Under Review.

[3] Xu, L., **Chai, K.**, Han, Z., Liu, H., Xu, C., Cao, Y., & Gao, F. (2023). An Efficient Trajectory Planner for Car-like Robots on Uneven Terrain. IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2023). arXiv preprint arXiv:2309.06115. STATUS: Published.

[4] Zhang, D., **Chai, K.**, Guo, P., Hu, Q., Li, J., & Shams, A. (2024). A novel full-process test bench for deep-sea in-situ power generation systems. Energy, 297, 131341. STATUS: Published.

[5] Chen, Y., Guo, P., Zhang, D., **Chai, K.**, Zhao, C., & Li, J. (2022). Power improvement of a cluster of three Savonius wind turbines using the variable-speed control method. Renewable Energy, 193, 832-842. STATUS: Published.

[6] Yuan, X., Li, R., **Chai, K.**, Qiu, Z. & Sun, X. (2022). Creative Design Based on Arduino — An Intelligent System of Plant Cultivation. Research and Exploration in Laboratory(02),74-78. doi:10.19927/j.cnki.syyt.2022.02.017. STATUS: Published.

✉ PATENT

[1] Zhou, Z., **Chai, K.**, Qiu, Z., Shu, H., Zhu, Y., Xing, H., Ye, S., Shen, Y. & Liu, B. (2021). A fast and uniform static load heating device and control method for high-speed aircraft. China National Intellectual Property Administration. CN202110462447.0. STATUS: Published.

[2] Guo, P., **Chai, K.**, Wang, J., Yin, Y., Zhang, D. & Chen, Y. (2022). A deep sea power generation system and its control method. China National Intellectual Property Administration. CN202210663338.X. STATUS: Published.

[3] Chen, Y., Li, J., **Chai, K.**, Zhou, J. & Xu, X. (2022). A passively regulated bidirectional tidal current energy generation device. China National Intellectual Property Administration. CN202210545692.2. STATUS: Published.

[4] Zhang, D., Guo, P., Yuan, X., Zhao, Y., Cheng, Y., **Chai, K.**, Yang, L. & Wang, Y. (2021). A Combined Lift and Drag Double Chain Hydraulic Turbine. China National Intellectual Property Administration. CN202110078616.0. STATUS: Published.

[5] Guo, P., **Chai, K.**, Chen, Y., Zhang, D., Wang, J., Qian, Y. & Liu, C. (2022). A land-based test platform and control method for deep sea power generation system. China National Intellectual Property Administration. CN202210662549.1. STATUS: Published.

ACADEMIC RESEARCH

Execute Long-Horizon Tasks with Mobile Manipulator Jan. 2024 – May. 2024

We build the hardware for a mobile manipulator and developed Inverse Kinematics (IK) code to control the arm's movement. The manipulator executes long-horizon tasks using pre-trained skills. Additionally, we design a mechanism to adjust the robot's initial position at the beginning of each sub-task to better align observations with the skills' training data distribution, thereby increasing the success rate of each sub-task.

Improving Localization Reliability with Path Planning Mar. 2023 – Sep. 2023

Derive a new metric for localization reliability through perturbation analysis and apply the metric to path planning, which enables the robot to avoid degraded areas in advance. Accepted by *IROS2024* [1].

Ground Effect-Aware Modeling and Control for Multicopters Sep. 2022 – Sep. 2023

Set up a mathematical model for ground effect prediction based on flown field simulation and experiments, making the drones fly safer and more stable near the ground. *Submitted to T-Mech* [2].

Motion Planning for Car-like Robots on Uneven Terrain Sep. 2022 – Mar. 2023

We propose a planning framework for wheeled robot movement on uneven terrain, which is efficient and allows robots to move safely. Accepted by *IROS2023* [3].

A Deep Sea Turbine Power Generation System (Senior Project) Aug. 2021 – Jul. 2022

Design a novel energy generation system that maintains the turbine at optimal power conversion efficiency in changing water flow. My undergraduate thesis received an A+ grade ($1^{st} / 25$). Accepted by *Energy* [4].

ENGINEERING PROJECT

Lightweight Multi-Robot LiDAR SLAM Framework with Loop Closure Sep. 2024 – Nov. 2024

Developed a lightweight multi-robot localization framework that supports intra-loop closures within individual trajectories and inter-loop closures between overlapping trajectories. To compensate for communication instability, a prior loop mechanism enables single robots to close loops with a pre-existing map.

Target Following Framework for Wheel-legged Robot Mar. 2023 – Jul. 2023

Enable a wheel-legged robot equipped with LiDAR and cameras to identify and follow specific targets. This project was completed with Huawei Shenzhen Application Scenario and Innovation Laboratory.

Helium-Assisted Drone for Flight Time Enhancement Dec. 2022 – Mar. 2023

Design a Helium-Assisted drone for floating advertisements in shopping malls. The buoyancy generated by the helium balloon offsets around 95% of the weight, extending the flight time from ten minutes to nearly an hour.

Motion planning for Drones to Avoid Collisions in Complex Structures Sep. 2022 – Dec. 2022

Build a drone using an onboard computer equipped with HiSilicon chips for Huawei. Deploy obstacle avoidance algorithms enabling the drone to fly safely in complex and dynamic environments.

Design of An Energy-efficient Heat Loading System Dec. 2021 – Jul. 2022

Design a new thermal simulation device to generate an even temperature field. To obtain better control strategies, we model the whole heat transfer process and utilize deep reinforcement learning technology.

Automatic detection of Surface Defects in Metal Product Apr. 2020 – Apr. 2021

We designed a system for a metal processing plant to monitor the production quality of products. With the help of industrial cameras and convolutional neural networks, we achieved a recognition recall rate of 94%.