Kaixin Chai

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Main Experience

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

Mobile manipulation, transition policy, Vision-Language-Action model, 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 motion 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

As a combination of interaction and mobility, mobile manipulators hold great potential for applications in various scenarios. However, despite significant progress in complex tabletop manipulation tasks, deploying such systems on mobile platforms remains highly challenging. The main reasons are as follows: First, mobile manipulation skills must account for additional factors, including the dynamics of manipulated objects and environmental obstacles. Second, mobility greatly increases the variability of background contexts, requiring the robot to learn the essential task-relevant information from data. Finally, ego-centric sensors reduce system observability, as sensors are typically mounted on the robot rather than providing a top-down view. These challenges make mobile manipulation tasks particularly difficult. I will focus on addressing the above issues.

Publication

[1] **Chai, K.***, Lee, H.*, Lim, J.J.(2025). N2M: Bridging Navigation and Manipulation via Learning Initial Pose Preference from Rollout. IEEE Robotics and Automation Letters (RA-L). STATUS: Under Review.
[2] Xu, L., **Chai, K.**, An, B., Gan, J., Wang, Q., Zhou, Y., ... & Gao, F. (2025). Tracailer: An Efficient Trajectory Planner for Tractor-Trailer Vehicles in Unstructured Environments. IEEE Transactions on Automation Science and Engineering (T-ASE). STATUS: Rebuttal.

[3] Yang, T., **Chai, K.**, Xu, L. & Gao, F. (2025). Ground Effect-Aware Modeling and Control for Multicopters: Enhanced Precision and Energy Efficiency. IEEE/ASME Transactions on mechatronics (T-Mech). STATUS: Published.

[4] **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: Published.

[5] 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.

[6] 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.

[7] 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.

[8] 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

Learning Transition Policy for Mobile Manipulation Feb. 2025 – Now

Data-driven approaches have shown great success in learning table-top interaction skills but face significant challenges when deployed on mobile manipulation systems. Specifically, factors such as data bias and reachability cause the success rate of pre-trained skills to vary greatly across different interaction locations. We propose a transition policy that guides the robot to the most suitable interaction position for task execution, thereby significantly improving the success rate of mobile manipulation tasks.

Factor Study of Imitation Learning Methods in Table-Top Manipulation Nov. 2024 – Now

Imitation learning has demonstrated remarkable capabilities in complex tabletop manipulation tasks. We observed an interesting phenomenon: under the same hardware, algorithm, and task conditions, the quality of training data has a significant impact on skill success rates. This project aims to identify the key factors in data collection. We investigate factors such as teleoperation methods, data amount, lighting condition, and the proportion of suboptimal trajectories, evaluating their effects on skill success rates across multiple tasks. This study provides detailed empirical insights to guide data collection for imitation learning.

Improving Localization Reliability with Motion Planning Mar. 2024 – Feb. 2025

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. Submitted to *T-ASE*.

Ground Effect-Aware Modeling and Control for Multicopters Sep. 2023 – Mar. 2024

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*.

Improving Localization Reliability with Motion 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*.

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*.

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 (*1st / 25*). Accepted by *Energy*.

⚙ Engineering Project

Multi-Robot LiDAR SLAM Framework with Loop Closure and BA	Sep. 2024 – Nov. 2024
Target Following Motion Planning for Wheel-legged Robot	Mar. 2023 – Jul. 2023
Helium-Assisted Drone for Flight Time Enhancement	Dec. 2022 – Mar. 2023
Motion planning for Drones to Avoid Collisions in Complex Structures	Sep. 2022 – Dec. 2022
Design and Control of a Heat Loader based on Deep Q Network	Dec. 2021 – Jul. 2022
Automatic detection of Surface Defects in Metal Product	Apr. 2020 – Apr. 2021