Kaixin Chai

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Education

Korea Advanced Institute of Science and Technology | Doctor of Philosophy Sep. 2025 – Now

Kim Jaechul Graduate School. Focus on Machine Learning, and Data-driven Control Theory.

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

I am working on enabling mobile robots to acquire whole-body skills, with a particular focus on data sources for skill training and the integration of whole-body controllers with high-level skill policies.

Publication

[1] **Chai, K.***, Lee, H.*, Lim, J.J. (2026). N2M: Bridging Navigation and Manipulation by Learning Pose Preference from Rollout. International Conference on Learning Representations. 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. arXiv preprint arXiv:2502.19832.

[3] Wang, L., Zhong, X., Xu, Z., **Chai, K.**, Zhao, A., Zhao, T., ... & Gao, F. (2025). LEMON-Mapping: Loop-Enhanced Large-Scale Multi-Session Point Cloud Merging and Optimization for Globally Consistent Mapping. IEEE Transactions on Robotics. arXiv preprint arXiv:2505.10018. STATUS: Major Revision

[4] Yang, T., **Chai, K.**, Ji, J., Wu, Y., Xu, C., & Gao, F. (2025). Ground-effect-aware modeling and control for multicopters. IEEE/ASME Transactions on Mechatronics, pages 1-12. doi: 10.1109/TMECH.2025.3583162.

[5] **Chai, K.***, Xu, L.*, Wang, Q., Xu, C., Yin, P., & Gao, F. (2024, October). LF-3PM: a LiDAR-based Framework for Perception-aware Planning with Perturbation-induced Metric. In 2024 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) (pp. 5372-5379). IEEE.

[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.

[7] Xu, L., **Chai, K.**, Han, Z., Liu, H., Xu, C., Cao, Y., & Gao, F. (2023, October). An efficient trajectory planner for car-like robots on uneven terrain. In 2023 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) (pp. 2853-2860). IEEE.

[8] 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.

Patent

[1] 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.

[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.

[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.

[4] 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.

[5] 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.

Main Research

Visuomotor Skill Learning for Humanoid Whole-body Manipulation Aug. 2025 – Sep. 2025
Chinese University of Hong Kong, advised by Zhongyu Li
I aim to enable humanoid robots to learn whole-body manipulation skills from a small number of human video demonstrations. This project involves three key challenges:

- Extracting interaction sequences from videos and retargeting them to humanoids;
- Training a robust whole-body controller based on limited reference samples;
- Acquiring generalizable skill policies given limited human demonstrations.

Bridging the Navigation and Manipulation Feb. 2025 – Jul. 2025
Korea Advanced Institute of Science and Technology, advised by Joseph J. Lim
As the project leader, I developed N2M, a transition module that optimizes robot positioning for mobile manipulation tasks, substantially enhancing task success rates through ego-centric observation-based guidance that generalizes across diverse environments with high data efficiency. Submitted to *RA-L*.

Factor Study of data collection for Table-Top Manipulation Nov. 2024 – Feb. 2025
Korea Advanced Institute of Science and Technology, advised by Joseph J. Lim
Examine various factors in data collection that influence the performance of IL-based manipulation, including teleoperation methods, data amount, lighting variations, suboptimal demonstrations, etc, which provides guidance for effective data collection. Although we didn't submit it, as the project co-leader, I learned a lot.

Spatial Bundle Adjustment for Multi-Robot Point Cloud Map Fusion Mar. 2024 – Feb. 2025
Zhejiang University, advised by Fei Gao
Developed LEMON-Mapping, a loop-enhanced framework for multi-robot point cloud fusion that resolves map inconsistencies through robust loop processing and spatial bundle adjustment. As the project co-leader, I conceived the original concept and implemented the initial algorithm. Submitted to *T-RO*.

Ground Effect-Aware Modeling and Control for Multicopters Sep. 2023 – Mar. 2024
Zhejiang University, advised by Fei Gao
Contributed as second author to developing a mathematical model for predicting ground effect in UAVs, specifically responsible for simulating drone flow fields to generate data for fitting and validating our ground effect model, ultimately enhancing drone near-ground stability and safety. Accepted by *T-Mech*.

Perception-aware Motion Planning for Robust Localization Mar. 2023 – Sep. 2023
Zhejiang University, advised by Fei Gao
As the project leader, I derived a new metric and a corresponding pipeline to enhance localization robustness through perturbation analysis, enabling robots to avoid being trapped in degraded areas. Accepted by *IROS2024*.

A Deep Sea Turbine Power Generation System (Senior Project) Aug. 2021 – Jul. 2022
Xi'an Jiaotong University, advised by Penghua Guo
I designed a novel energy generation system that maintains the turbine at optimal power conversion efficiency in varying water flow conditions. 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

Skills

Software: MATLAB, C++/Python, ROS1/2, Machine Learning, MuJoCo, Isaac Gym/Lab.

Hardware: 3D Modeling and Fabrication, Circuit Design, Arduino/51/STM32 Programming.