

EDUCATION

Shanghai Jiao Tong University, Robot Institute

Master of Engineer, Mechanical Engineering; GPA: 3.96/4 (rank 2/176)

Shanghai, China

Sept. 2022 - Expected Jun. 2025

Shanghai Jiao Tong University, The School of Mechanical Engineering

Bachelor of Engineer (with honors), Mechanical Engineering; GPA: 3.71/4.3 (rank 16/180)

Shanghai, China

Sept. 2018 - Jun. 2022

University of California, Berkeley, MSC-Lab

Research Assistant advised by Masayoshi Tomizuka

Berkeley, CA

May 2024 - Now

AWARDS

- National Scholarship, 2023, 2020, Top 2%
- Shanghai Merit Graduate, 2022, Top 2%
- Shanghai-FANUC Scholarship, 2021, Top 1%
- Zhiyuan Honors Degree, 2022, Top 1.5%
- Agilent Scholarship, 2022, Top 3%
- Zhiyuan Honors Scholarship, 2018, 2019, 2020, 2021, Top 5%

PUBLICATIONS(*EQUAL CONTRIBUTION)

- [1] **K. Song**, G. Chen, W. Liu, and Z. Xiong, "Multi-Robot Rendezvous in Unknown Environment with Limited Communication," *Robotics and Automation Letters*, 2024, in press
- [2] G. Chen, **K. Song**, X. Xu, W. Liu, and Z. Xiong. "RHAML: Rendezvous-based Hierarchical Architecture for Mutual Localization," *Robotics and Automation Letters*, vol. 9, no. 7, pp. 6440-6447, July 2024, doi: 10.1109/LRA.2024.3406056
- [3] **K. Song**, W. Liu, G. Chen, X. Xu, and Z. Xiong, "FHT-Map: Feature-based Hybrid Topological Map for Relocalization and Path Planning," *Robotics and Automation Letters*, vol. 9, no. 6, pp. 5401-5408, June 2024, doi: 10.1109/LRA.2024.3392493
- [4] S. Li*, **K. Song***, B. Yang*, Y. Gao, and X. Gao, "Preliminary assessment of the COVID-19 outbreak using 3-staged model e-ISHR," *Journal of Shanghai Jiaotong University*, vol. 25, pp. 157-164, April 2020, doi: 10.1007/s12204-020-2169-0
- [5] [Submitted] **K. Song**, G. Chen, Z. Xiong, M. Tomizuka, M. Ding, and W. Zhan "P² Explore: Efficient Exploration in Unknown Clustered Environment with Floor Plan Prediction," *International Conference on Robotics and Automation*, 2024
- [6] [Preparing] G. Chen, **K. Song**, W. Liu, W. Ma, and Z. Xiong, "A Novel Dynamic Localization Graph for High-Accuracy Mutual Localization"
- [7] [Revising] W. Liu, **K. Song**, M. Ren, M. Wang, and Z. Xiong, "Motion Planning for Multiple Mobile Manipulator System in Complex Flipping Manipulation," *IEEE/ASME Transactions on Mechatronics*, 2023
- [8] [Under Review] W. Liu, M. Ren, **K. Song**, M. Wang, and Z. Xiong, "Distributed Motion Control of Multiple Mobile Manipulator System with Disturbance and Communication Delay," *IEEE Transactions on Automation Science and Engineering*, 2024
- [9] [Revised] M. Ren, W. Liu, **K. Song**, L. Shi, and Z. Xiong, "Containment Control of Multi-Robot Systems with Non-uniform Time-varying Delays," *IEEE Transactions on Robotics*, 2024

RESEARCH INTERESTS

- **Multi-robot SLAM System**: Single/Multi Robot Active SLAM, Topological Mapping, LiDAR-based SLAM, Visual SLAM
- **Robot Learning**: Place Recognition, Diffusion Model, Relative Pose Estimation, Reinforcement Learning
- **Navigation and Path Planning**: Rendezvous Problem, Path Searching, A* algorithm, Motion Planning for Mobile Manipulator
- **Multi-Robot Manipulation and Control**: Multiple Mobile Manipulator, Cooperative Manipulation, Containment Control

ACADEMIC SERVICES

- **Journal Reviewer**: IEEE Robotics and Automation Letters (RA-L)
- **Conference Reviewer**: 2023, 2024 Advanced Intelligent Mechatronics (AIM)

RESEARCH EXPERIENCE

Exploration in Clustered Environment with Floor Plan Prediction [5]

May 2024 - Now, Berkeley, CA

Mechanical Systems Control Lab (MSC-Lab), Supervisor: Masayoshi Tomizuka

University of California, Berkeley

- Implemented **floor plan prediction** in the task of indoor environment exploration. 2D maps of scenes in KTH floor plan dataset are collected for the training process. UNet++ is used for denoising and UNet is used for floor plan prediction. Then, the local predicted maps are merged for **global predicted map**. Room segmentation and their topology are also extracted for the downstream task.

Multi-robot Rendezvous in unknown environment [1]

Sept. 2023 - Aug. 2024, Shanghai, China

Robot Control and Machine Vision Lab, Supervisor: Zhenhua Xiong

Shanghai Jiao Tong University

- Divided rendezvous task into **two stages**: incomplete exploration of the environment with relative pose (RP) estimation, and rendezvous point selection. Partitioned and incomplete exploration for rendezvous (**PIER**) is proposed firstly. Then, lightweight **topological maps** are constructed to represent the environmental structure and shared among robots for RP estimation. Finally, when an **optimal rendezvous point** is selected based on the merged topological map

Motion Planning for Multiple Mobile Manipulator System [7,8]

Jun. 2023 - Now, Shanghai, China

Robot Control and Machine Vision Lab, Supervisor: Zhenhua Xiong

Shanghai Jiao Tong University

- Proposed a novel planning framework for **complex flipping manipulation** by incorporating platform motions and regrasping. Two types of trajectories, mobile manipulator planning and regrasping planning, are classified and assigned different priorities for various tasks. Comprehensive experiments emphasize the significance of proposed planner in extending the capabilities of multiple mobile manipulator systems in complex tasks

Rendezvous-based Mutual Localization [2]

Aug. 2023 - Apr. 2024, Shanghai, China

Robot Control and Machine Vision Lab, Supervisor: Zhenhua Xiong

Shanghai Jiao Tong University

- Proposed a novel rendezvous-based hierarchical architecture for mutual localization (**RHAML**). Firstly, anisotropic convolutions are introduced into the network, yielding **initial localization results**. Then, the **iterative refinement** module with rendering is employed to adjust the observed robot poses. Finally, the **pose graph** is used to optimize all localization results

Feature-based Hybrid Topological Mapping [3]

Jan. 2023 - Feb. 2024, Shanghai, China

Robot Control and Machine Vision Lab, Supervisor: Zhenhua Xiong

Shanghai Jiao Tong University

- Proposed a featured-based hybrid topological map (**FHT-Map**). Lightweight **support nodes** are introduced in traditional topological maps with main nodes only. **Relocalization** and **path planning** algorithms are realized based on FHT-Map, which is capable of reducing **storage requirements** compared with geometric maps and benefiting **path planning** capability compared with traditional topological maps

Design of Soft Pneumatic Actuator using TPMS

Sept. 2020 - Sept. 2021, Shanghai, China

Soft Robotics Lab, Supervisor: FeiFei Chen

Shanghai Jiao Tong University

- Proposed a new class of **soft pneumatic actuators** with single-material, uniaxial deformation, high energy density, and scalability, purely based on periodic curved air channels. And the shape of channels is implicitly parameterized by modified triply periodic minimal surfaces (mTPMS). And this kind of actuator can be used as artificial muscles in the future

PROJECTS WITH ENTERPRISE

- Multi Robot LiDAR-based SLAM and Exploration:** Multi robot system is utilized to explore the unknown environment, GMapping is used for localization and mapping. Map merging algorithms are performed
- Robotic Arm based Scanning of Unknown Surfaces:** The robotic arm is equipped with an Eddy Current Sensor for metal part defect detection. A coverage path is planned for scanning potential defect

TEACHING EXPERIENCE

- Teaching Assistant:** ME3403 *Introduction to Robotics* Spring, 2024, Shanghai Jiao Tong University
- Teaching Assistant:** ME4409 *Multi-robot System and Control* Fall, 2024, Shanghai Jiao Tong University

SKILLS

- Language:** Mandarin Chinese (Native), English (Fluent)
- Programming:** Proficient in Python, Matlab, Linux, and ROS; familiar with C++, Git
- Libraries:** Proficient in Numpy, PyTorch, Ceres, OpenCV, PCL, MoveBase; familiar with Moveit, Pandas