Kun Song

⚲ Shanghai Jiao Tong University, Shanghai, China

✉ coldtea@sjtu.edu.cn

⌂ Personal Website

☎ 86-13616543101

EDUCATION

Shanghai Jiao Tong University, Robot Institute   Shanghai, China
Master of Engineer, Mechanical Engineering; GPA: 3.96/4 (rank 2/176)   *Sept. 2022 - Expected Jun. 2025*
Honors and Awards: National Scholarship (2023, Top 2%), Agilent Scholarship (2022)

Shanghai Jiao Tong University, The School of Mechanical Engineering   Shanghai, China
Bachelor of Engineer (with honors), Mechanical Engineering; GPA: 3.71/4.3 (rank 16/180)   *Sept. 2018 - Jun. 2022*
Honors and Awards: Shanghai Outstanding Graduate (2022), National Scholarship (2020, Top 2%), Shanghai-FANUC Scholarship(2021)

RESEARCH EXPERIENCE

Feature-based Hybrid Topological Mapping   Jan. 2023 - Now, 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** were introduced in traditional topological maps with main nodes only. **Relocalization** and **path planning** algorithms were realized based on FHT-Map, which is capable of reducing **storage requirements** compared with geometric maps and benefiting **path planning** compared with traditional topological maps.

Multi-robot Rendezvous in unknown environment   Sept. 2023 - Now, Shanghai, China
Robot Control and Machine Vision Lab, Supervisor: Zhenhua Xiong   *Shanghai Jiao Tong University*

- Rendezvous is divided into **three stages** in this work: incomplete exploration of the environment, relative pose (RP) estimation, and rendezvous point selection. Partitioned and incomplete exploration for rendezvous (**PIER**) is proposed firstly, and lightweight **topological maps** are constructed and shared among robots for RP estimation and representation of environmental structure. Finally, an **optimal rendezvous point** is selected based on the merged topological map.

Rendezvous-based Mutual Localization   Aug. 2023 - Now, Shanghai, China
Robot Control and Machine Vision Lab, Supervisor: Zhenhua Xiong   *Shanghai Jiao Tong University*

- To enhance the precision of localization, a novel rendezvous-based hierarchical architecture for mutual localization (**RHAML**) is proposed. 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.

Motion Planning for Multiple Mobile Manipulator System   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, were classified and could be assigned different priorities for different tasks. Comprehensive experiments emphasized the significance of proposed planner in extending the capabilities of multiple mobile manipulator systems in complex tasks

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.

PUBLICATIONS

- **Song K**, Liu W, Chen G, et al. FHT-Map: Feature-based Hybrid Topological Map for Relocalization and Path Planning. **Robotics and Automation Letters**, 2024

- [Preparing] **Song K**, Chen G, Liu W, et al. Multi-Robot Rendezvous in Unknown Environment with Limited Communication.

- [Revised] Gaoming C, **Song K**, Xiang X, et al. RHAML: Rendezvous-based Hierarchical Architecture for Mutual Localization. RAL, 2024

- [Revising] Liu W, **Song K**, Ren M, et al. Motion Planning for Multiple Mobile Manipulator System in Complex Flipping Manipulation. TMech, 2023

- [Under Review] Liu W, Ren M, **Song K**, et al. Distributed Motion Control of Multiple Mobile Manipulator System with Disturbance and Communication Delay. RAL, 2024

- [Under Review] Ren M, Liu W, **Song K**, et al. Containment Control of Multi-Robot Systems with Non-uniform Time-varying Delays. TRO, 2024

- Li S*, **Song K***, Yang B*, et al. Preliminary assessment of the COVID-19 outbreak using 3-staged model e-ISHR[J]. Journal of Shanghai Jiaotong University (Science), 2020, 25: 157-164.

RESEARCH INTERESTS

- **SLAM System**: Tological Mapping, LiDAR-based SLAM, Visual SLAM, Single/Multi Robot Active SLAM
- **Deep Learning in Robotics**: Place Recognition, Relative Pose Estimation, Reinforcement Learning
- **Navigation and Path Planning**: Path Searching, A* algorithm, Motion Planning for Mobile Manipulator
- **Multi-Robot Manipulation**: Rendezvous Problem, Multiple Mobile Manipulator, Cooperative Manipulation

Projects & Skills

- **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.
- **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