JINGTAO TANG (汤景韬)

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EDUCATION

Ph.D. Student (Computing Science)
@ SFU Jan.'23 –Now

M.Eng. (Software Engineering)
@ ECNU Sep.'18 –Jun.'21

B.Eng. (Software Engineering)
@ ECNU Sep.'18 –Jun.'21

RESEARCH INTERESTS

- Multi-Robot System
- Heuristic Search
- Automated Planning
- Reinforcement Learning
- Combinatorial Optimization

AWARDS

Best Paper Award of RSS Workshop on MRS

SFU-FAS Graduate Fellowship

Robar Industries Ltd Graduate Scholarships

Ebco Eppich Scholarships

Outstanding Graduate Student of Shanghai and ECNU

National Scholarship of China

SERVICES

Conference Reviewers: ICRA, IROS, AAAI, ECAI, ICAPS

Journal Reviewers: T-RO, RA-L, RAS, EAAI

Organizers: NWRS-25

Volunteers: AAAI-24, ROS Summer School China 18-20

ABOUT ME

*I am Jingtao Tang, currently a Ph.D. candidate in **AIRob** lab supervised by Professor Hang Ma at Simon Fraser University. My current research focuses on various planning problems for (multi-) robot systems. Before that, I worked at the Shenzhen Institute of Artificial Intelligence and Robotics for Society, and studied in the Intelligent Motion Planning and Vision Laboratory at East China Normal University (ECNU). I'm strongly motivated to empower multiple robots with versatile skills to address practical applications in daily lives.*

EXPERIENCES

Mixed Discrete/Continuous Planning on Graphs of Convex Sets (GCS)

Ph.D. Student Dec. 2024 – Now SFU AIRob Lab

This topic involves planning on GCS — a powerful representation that decomposes the configuration space into convex regions connected by a graph. GCS naturally renders classic graph optimization problems into mixed discrete/continuous problems:

1. **Multi-Agent Pathfinding (MAPF) to Multi-Robot Motion Planning (MRMP)**: We propose Space-Time GCS (ST-GCS), which systematically covers space-time collision-free regions with convex sets rather than random sampling. ST-GCS extends GCS into the time dimension, formulating time-optimal trajectories through unified convex optimization with velocity bounds and flexible arrival times.
2. **Traveling Salesman Problem (TSP) to GCS-TSP**: We developed a hierarchical framework optimally solving GCS-TSP where edge costs depend on trajectory selection through convex regions. It combines combinatorial tour search with convex trajectory optimization. We demonstrated on various GCS-TSP applications, including coverage and inspection planning, and task and motion planning.

Multi-Robot Coverage Path Planning (MCPP)

Ph.D. Student Jan. 2023 – Nov. 2024 SFU AIRob Lab

MCPP plans for multiple robots to jointly cover a given workspace. This topic encompasses the following projects via combinatorial optimization and heuristic search:

1. **Graph-Based Formulation**: We formulated MCPP as a min-max tree cover problem using mixed-integer linear programming on a grid graph representation of the workspace. While optimal, it scales only to 32×32 grids with 12 robots.
2. **Large-Scale MCPP with Local Search**: We developed an efficient framework scaling to 256×256 grids with 100 robots, featuring a bounded-suboptimal single-robot CPP algorithm and adaptive spatiotemporal deconflicting for real-world deployment.
3. **Global MCPP with Space-Filling Curves**: We extended connected *Fermat* spiral algorithms from 3D printing into MCPP, generating smooth, continuous coverage paths for arbitrarily-shaped workspaces without grid decomposition.

Planning for Decentralized Heterogeneous Multi-robot System (HMRS)

Research Assistant Jul. 2021 – Dec. 2022 AIRS/CUHKSZ

This topic covers two Deep Reinforcement Learning (DRL) research projects:

1. **Coverage Planning**: We developed an RL solution for energy-limited worker robots and unlimited-energy station robots, where the workers are dedicated to coverage work and the stations recharge the workers. We trained the system with intrinsic curiosity and curriculum learning to address sparse rewards. The system was successfully deployed in real-world multi-robot applications.

2. **Adaptive Formation Control**: We considered the problem of coordinating a decentralized HMRS of quadrotors for adaptive formation control, where the formation evolves throughout the task. We formulated it as goal-conditioned RL, achieving rapid training in minutes using IsaacGym's GPU-accelerated parallel processing.

Robot Swarms for Large-scale Ecological Restoration Task

Master Student | Jun. 2019 – Apr. 2021 | ECNU

In this project, we aimed to deploy multiple robots for the ecological restoration task in deserts. We abstracted the task into two research problems: 1) multi-robot coverage path planning with energy constraints; 2) generating feasible terrain-adaptive trajectories for wheeled robots. The system was successfully deployed in two deserts in China.

Projection Formats for Encoding 360° Virtual Reality (VR) Videos

Master Student | Aug. 2018 – May. 2019 | ECNU

In this project, we aimed to improve the user experiences of telepresence for VR headsets. The main idea is to design efficient formats to encode/decode panoramic VR videos as regular rectangular videos for storage and content distribution.

PUBLICATIONS

- Space-Time Graphs of Convex Sets for Multi-Robot Motion Planning | **Jingtao Tang**, Zining Mao, Lufan Yang, Hang Ma | International Conference on Intelligent Robots and Systems 2025 (IROS-25); Robotics: Science and Systems 2025 Workshop on Scalable and Resilient Multi-Robot Systems (**Best Paper Award**) | Homepage | Code
- Large-Scale Multi-Robot Coverage Path Planning on Grids with Path Deconfliction | **Jingtao Tang**, Zining Mao, Hang Ma | IEEE Transactions on Robotics (T-RO), vol. 41, pp. 3348-3367, 2025 | Homepage | Code
- Multi-Robot Connected Fermat Spiral Coverage | **Jingtao Tang**, Hang Ma | The 34th International Conference on Automated Planning and Scheduling (ICAPS-24) | Code
- Large-Scale Multi-Robot Coverage Path Planning via Local Search | **Jingtao Tang**, Hang Ma | The 38th AAAI Conference on Artificial Intelligence (AAAI-24) | Homepage | Code
- Mixed Integer Programming for Time-Optimal Multi-Robot Coverage Path Planning with Efficient Heuristics | **Jingtao Tang**, Hang Ma | IEEE Robotics and Automation Letters (RA-L), vol. 8, no. 10, pp. 6491-6498, (2023) | Code
- TMSTC*: A Turn-minimizing Algorithm For Multi-robot Coverage Path Planning | Junjie Lu, Bi Zeng, **Jingtao Tang**, Tin Lun Lam, Junbin Wen | IEEE Robotics and Automation Letters (RA-L), vol. 8, no. 8, pp. 5275-5282, (2023) | Code
- Learning to Coordinate for a Worker-Station Multi-robot System in Planar Coverage Tasks | **Jingtao Tang**, Yuan Gao, Tin Lun Lam | IEEE Robotics and Automation Letters (RA-L), vol. 7, no. 4, pp. 12315-12322, (2022)
- MSTC*: Multi-robot Coverage Path Planning under Physical Constraint | **Jingtao Tang**, Chun Sun, Xinyu Zhang | 2021 IEEE International Conference on Robotics and Automation (ICRA-21) | Code
- A Hybrid Projection Format for Encoding 360 VR Videos | **Jingtao Tang**, Xinyu Zhang | 2019 IEEE International Conference on Virtual Reality and 3D User Interfaces (VR)