### Chengkai Wu

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Education

#### Harbin Institute of Technology, Shenzhen

2022/09 -- 2024/12 (Expected)

M.Eng in Control Engineering

Shenzhen, China

• Optimization Method(A+), Nonlinear and Adaptive Control(A+), Optimal Estimation(A+), Machine Learning(A), etc

**Xidian University** 2018/09 -- 2022/06

**B.Eng in Electronic Information Engineering** 

Xi'an, China

• GPA: 3.8/4.0, Rank: Top 1%

• Advanced Mathematics(99), Linear Algebra(96), Intelligent Robot(96), Signals and Systems(100), etc.

#### Research Interests

My research interests center on robotics motion planning and control, utilizing both optimal control and reinforcement learning methods to generate safe and smooth locomotions.

**Publications** 

## Real-time Whole-body Motion Planning for Mobile Manipulators Using Environment-adaptive Search and Spatial-temporal Optimization Yokohama, Japan

**Chengkai Wu**\*, Ruilin Wang\*, Mianzhi Song, Fei Gao, Jie Mei, Boyu Zhou<sup>†</sup>.

2024 IEEE International Conference on Robotics and Automation (ICRA 2024). [Paper] - Oral Presentation

### Real-time Planning for Interaction-Aware Autonomous Exploration with an Eye-in-hand Mobile Manipulator Atlanta, United States

Mianzhi Song, **Chengkai Wu**, Jinni Zhou, Jie Mei, Boyu Zhou<sup>†</sup>.

In Submission - 2025 IEEE International Conference on Robotics and Automation (ICRA 2025).

### A Whole-body Planning and Control Framework for Mobile Manipulators with End-effector Pose Constraints Shuo Su, Tanghao Qin, Chengkai Wu, Jia Hu, Youmin Gong, Jie Mei<sup>†</sup>.

In Submission - IEEE Robotics and Automation Letters (RAL).

**Projects** 

#### A Robust and Efficient Mobile Manipulation Architecture for Pick-and-Placing Task

2024/01 -- Now

Visiting Student, advised by Prof. Boyu Zhou

Zhuhai, China

- Designed a real-time path planning method for manipulation-on-the-move tasks using reachability maps and progress heuristics.
- Developed an optimization-based trajectory generation method for efficient pick-and-place task execution.

#### Real-time Planning for Interaction-Aware Autonomous Exploration

2023/06 -- 2024/09

Visiting Student, advised by Prof. Boyu Zhou

Zhuhai, China

- Developed a Constrained Reachability Database (CRD) to enable real-time retrieval of feasible whole-body configurations for given viewpoints and significantly reducing inverse kinematics computation time.
- Formulated an Asymmetric Generalized Traveling Salesman Problem (AGTSP) approach to optimize the selection of whole-body configurations and the visiting sequence for multiple viewpoints, minimizing the movement costs for both the mobile base and the manipulator.
- Submitted one paper to ICRA 2025.

#### Air-Ground Coordinated Patrol and Tracking

2024/01 -- 2024/08

Algorithm Engineer, advised by Prof. Boyu Zhou

Zhuhai, China

- Developed a drone trajectory planner with yaw angle planning, successfully applied to exploration and patrol tasks.
- Proposed a novel method for enabling ground robots to identify traversable areas in 3D environments based on their current location.

#### DJI RoboMaster 2022-2023,2023-2024 University AI Challenge Competition - Team MAS

2022/09 -- 2024/04

Team Leader, advised by Prof. Jie Mei

Shenzhen, China

• Developed a Kinodynamic A\*-based path planning algorithm for real-time drone gate-traversal paths.

- Designed an optimization-based trajectory generation method for gate traversal, avoiding static and dynamic obstacles.
- Implemented a drone SE(3) controller, achieving an average gate traversal speed exceeding 8m/s in simulation.
- Devised a prior-based landing zone localization correction scheme.
- Constructed a drone platform; in competition, successfully traversed all ten target gates in 39 seconds.
- Won **Second Place** in the National Competition and **Third Place** in the Classic Competition.

# Real-time Whole-body Motion Planning for Mobile Manipulators Using Environment-adaptive Search and Spatial-temporal Optimization 2023/01-2023/09

Visiting Student, advised by Prof. Boyu Zhou

Zhuhai, China

- Designed an environment-adaptive path searching method for mobile manipulators, achieving a higher quality path with reduced computation time compared to *RRT\*-Connect*.
- Developed a spatial-temporal optimization method to generate smooth, agile, safe, and dynamically feasible trajectories for mobile manipulators, outperforming CHOMP by a factor of approximately 10 in computation time efficiency.
- Established a physical platform for mobile manipulators, achieving real-time whole-body trajectory planning within 500ms in indoor scenes containing various obstacles using onboard computer.
- Published one paper to ICRA 2024.

#### **Numerical Optimization in Robotics**

2022/07 -- 2022/09

Excellent Student, advised by Dr. Zhepei Wang

China

- Implemented collision-free polynomial trajectory generation in environments with convex obstacles based on the LBFGS algorithm.
- Achieved efficient computation of minimum collision distance using the Low-Dimensional QP algorithm.
- Implemented Ackerman model predictive control (MPC) trajectory tracking based on the PHR-ALM algorithm.
- Solved the time-optimal path parameterization (TOPP) problem using the Conic ALM algorithm.

#### Field Autonomous System & Computing Lab - Zhejiang University

2021/07 -- 2021/09

Research Assistant, advised by Prof. Yanjun Cao and Fei Gao

Huzhou, China

- Designed and developed a finite-state machine-based drone task switching module, ensuring reliable and stable task transitions.
- Developed drone path planning functionalities, such as approach path generation, target detection path generation, and safe return-to-home.
- Developed a ROS Qt-based drone operation interface for real-time visualization of flight data.
- Successfully deployed functionalities to a physical drone and participated in a competition, achieving **Second Place**.

### Open-Source Projects

#### Smart Autonomous Robotics Group

2023/01 - Present

• Contributor of ♠ REMANI-Planner (★62). A motion planning method capable of generating high-quality, safe, agile and feasible trajectories for mobile manipulators in real time.

### Honors and Awards

Third Place - DJI RoboMaster 2023-2024 University AI Challenge - Classic	Apr. 2024
Second Place - DJI RoboMaster 2022-2023 University AI Challenge	Nov. 2022
Honorable Mention - Mathematical Contest in Modeling	Dec. 2021
Provincial First Prize - Contemporary Undergraduate Mathematical Contest in Modeling	Dec. 2020
School First-Class Academic Scholarship	Oct. 2023
School First-Class Academic Scholarship	Sep. 2020
First-class Senior Scholarship (2/495)	Dec. 2020

#### **Technical Skills**

- Programming Languages: C/C++(ROS), Python, MATLAB
- Tools: Gazebo, Isaac Sim, Unity, PX4, Git, LaTeX, LBFGS, ACADOS, Pytorch, LaTeX
- Theoretical Knowledge: Motion Planning, Numerical Optimization, Forward/Inverse Kinematics, Model Predictive Control (MPC), Reinforcement Learning
- Languages: Chinese (Native), English (IELTS: 7)