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

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 **(★38)**. A motion planning method capable of generating high-quality, safe, agile and feasible trajectories for mobile manipulators in real time.

Multi-Agent System Lab 2022/09 - Present

- **Contributor of** SE(3) Controller. A SE(3) Controller for quadrotors.

Personal Projects 84 followers ck1201

- **CF-MPC** A Model Predictive Control Framework for Quadrotor Trajectory Tracking and Obstacle Avoidance with Flight Corridor Constraints.

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), Imitation Learning, Reinforcement Learning

- **Languages**: Chinese (Native), English (CET-6: 584)

Last Updated on October 5, 2024