Kaiwen JIANG

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Education

Harbin Institute of Technology, Shenzhen Shenzhen, CHN
Bachelor of Engineering in Automation *Sep. 2020 – Jun. 2024*

- CGPA: 3.658/4.0; Final-year GPA: 91.34/100
- Comprehensive Ranking: 24/236
- Academic Scholarship: Second Prize (Ranking 18/236)

Publications & Preprints

- Kaiwen Jiang etc. "Learning Whole-Body Loco-Manipulation for Omni-Directional Task Space Pose Tracking with Wheeled-Quadrupedal-Manipulator", submitted to IEEE Robotics and Automation Letters.
- Kaiwen Jiang, Zhi Li, Ying Zhang, "An Inversion-free Iterative Algorithm with a Scalar Tuning Parameter for Coupled Riccati Matrix Equation" *IEEE Transactions on Automatic Control TAC*, accepted, 2024.
- Kaiwen Jiang, Zhi Li, Ying Zhang, "The Structure-preserving Doubling Algorithm for the Discrete Coupled Riccati Matrix Equations," *Proceedings of the 2nd Conference on Fully Actuated System Theory and Applications*, July 14-16, 2023

Research

Research Assistant Aug. 2024 – Present
Control & Learning for Robotics and Autonomy(CLEAR) Lab SUStech University
Supervisor: Prof. Wei Zhang *School of System Design and Intelligent Mfg.*
Co-Supervisor: Prof. Hua Chen *School of System Design and Intelligent Mfg.*

- Pending. I am eager to venture into diverse fields, e.g. I am now interested in model-based RL, AMP & ASE, learning based perceptive loco-manipulation, transformer/diffusion policy application on quadrupeds/humanoid.

Visiting Research Student Sep. 2023 – Aug. 2024
Control & Learning for Robotics and Autonomy(CLEAR) Lab SUStech University
Supervisor: Prof. Wei Zhang *School of System Design and Intelligent Mfg.*
Co-Supervisor: Prof. Hua Chen *School of System Design and Intelligent Mfg.*

- Model-based Control: Developed a controller based on NMPC and WBC to achieve synergistic control for the quadrupedal manipulator platform. More specifically, we achieved Chicken Head Motion in reality and filmed a demo, which can demonstrate the collaboration capacity and the stability of this method.
- Learning-based Control: Leveraging reinforcement learning (RL) to achieve whole-body coordination and realize loco-manipulation for omni-directional task space pose tracking with wheeled quadrupedal manipulator.

Undergraduate Research Assistant Aug. 2022 – Sep. 2023
ZHANG Ying's Lab Harbin Institute of Technology, Shenzhen
Supervisor: Prof. Ying Zhang *School of Mechanical Engineering and Automation*

- Numerical Algorithm: Proposed an inversion-free iterative algorithm with a scalar tuning parameter for coupled Riccati matrix equations(DCRMEs), the algorithm completely circumvents the need for matrix inversion during the iterative process, leading to significant improvements in convergence speed and numerical stability compared to certain benchmark algorithms.

- Optimal Control: Presented a structure-preserving doubling algorithm (SDA) tailored for the DCRMEs. Notably, SDA exhibits the advantageous properties of global convergence and quadratic convergence rate. However, a significant challenge lies in the specific form required for implementing SDA. Consequently, we solve this issue by transforming the conversion of DCRMEs into the specific form required by SDA.

Honors & Awards

Finalist in the Mathematical Contest In Modeling (MCM),(Top 2%)	2022.11–2023.3
National Second Prize in the China Robot and Artificial Intelligence Competition(CRAIC)	2023.3–7
Provincial First Prize in National College Students Mathematical Contest in Modeling	2022
Academic Scholarship: Second Prize (Ranking 18/236)	2023

Selected Projects

Legged & Manipulator Collaboration Control Sep. 2023 – Nov. 2023

Advisors: Prof. Wei Zhang, Prof. Hua Chen *SUStech*

- **Main Tasks:** (1)We expect to develop a controller based on NMPC and WBC for synergistic control of the legged & manipulator platform. Our dog is the *Aliengo* of Unitree and the arm is the $Z1$ of Unitree. (2) It is expected to achieved a Gamepad Control Mode, via which we can manipulate the End-effector(Ee) and/or the dog. We alse anticipate to control Ee and/or dog through Rviz interaction. More specifically, for example, moving Ee to a specific position in the simulation, will also result the corresponding movement in reality.
- **Challenges:** (1) Adjust NMPC's parameters. (2) Adjust WBC's parameters. (3) The problem of sim-to-real. (4) The limitation induced by hardware and the drawback of NMPC. (5)The problem of data visualization
- **Action:(Greatly simplified version):** (1)Usage of dynamic reconfiguration (2)Avoid cheater configuration (3)Self-designed low-pass filter to optimize the reference trajectory of velocity. (4) Deploy the Hierarchical WBC
- **Result:** We achieved "Chicken Head" Motion in real world, which can demonstrate the collaboration capacity and the stability of our control.

The Six-axis Arm Plays the Xylophone Mar. 2023 – May 2023

Advisor: Prof. Yunjiang Lou, Associate Dean *HITSZ*

- **Main Task**: Our aim is to let the manipulator move along a particular trajectory, which is exactly the one that lead the End-effector(Ee), a plastic hammer, to hit the xylophone and play a song.
- **Action:** (1)We use MATLAB to do the arm's motion planning, using **LFPB with Via Points** trajectory planning. A user interface was developed for appointing certain melody that the arm should play. (2)Instead of utilizing some existing APIs, We programmed PoE's forward kinematic, inverse kinematic and the transformation of different expressions of orientation by ourselves.

Reinforcement Learning for Training a Prey Aug. 2023 – Sep. 2023

Advisor: Prof. Hao Xiong *HITSZ*

- **Main Task:** In a finite two-dimensional world, there are a Predator, a Prey, some obstacles and a shelter. Prey's mission is to escape from the Predator and get into the shelter. Predator is already a smart enough agent, and Prey is what we're going to train.
- **Action:** We use the renowned frame named PPO to train the prey, use TensorBoard to visualize the training process, reward effect proportion etc. I got full marks in this course.

Skills

Languages: English (*IELTS* Band 7), Mandarin Chinese (native)

Programming: C/C++, Python, MATLAB/Simulink, Arduino, LaTeX

Tools: Git, PyTorch, PPO, ROS, VS Code, Ubuntu, Overleaf, PPT, MS word