

Mingrui Luo

Ph.D. Student

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Education

School of Artificial Intelligence | University of Chinese Academy of Sciences (UCAS)

Ph.D. Student in Control Theory and Control Engineering **GPA: 3.85/4.0**

Sep. 2020 - Now

Faculty of Materials and Manufacturing | Beijing University of Technology (BJUT)

B.E. Degree in Mechanical Engineering (Major) and Robot Engineering (Minor) **GPA: 3.93/4.0 (Rank 1st)**

Sep. 2016 - Jun. 2020

Technical Skills

Programming

Python, Matlab, C, C++, JavaScript

Professional Softwares

ROS, SolidWorks, AutoCAD, PyBullet, CoppeliaSim, Mujoco, Codesys, Keil, Altium Designer, ANSYS, etc.

Drawing & Typesetting

Office, L^AT_EX, Visio, Photoshop, Premiere, etc.

Publications

Journal Articles

- [1] **Mingrui Luo**, En Li*, Aoshun Zhang, Min Tan, Zize Liang. "A Bioinspired Coiled Cable-Driven Manipulator: Mechatronic Design and Kinematics Planning with Multi-Constraints," *IEEE/ASME Transactions on Mechatronics*, 1-12, 2023. [Link](#)
- [2] **Mingrui Luo**, En Li*, Rui Guo, Jiaxin Liu, Zize Liang. "End-Effector Pose Estimation in Complex Environments Using Complementary Enhancement and Adaptive Fusion of Multisensor," *Journal of Sensors*, 1-18, 2021. [Link](#)
- [3] **Mingrui Luo**, Yunong Tian, En Li*, Minghao Chen, Min Tan. "A Local Obstacle Avoidance and Global Planning Method for the Follow-the-Leader Motion of Coiled Hyper-Redundant Manipulators," *IEEE Transactions on Industrial Informatics*, Under Review, 2023.

Conference Proceedings

- [1] **Mingrui Luo**, En Li*, Yunong Tian, Minghao Chen, Min Tan, et al.. "A Novel Coiled Cable-conduit-driven Hyper-redundant Manipulator for Remote Operating in Narrow Spaces," *2023 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, Accepted.
- [2] **Mingrui Luo**, En Li*, Rui Guo, Shengchuan Li, Cunfeng Kang. "An Active and Adaptive Image Enhancement Method for Applications in Low-Light and Narrow Environment," *2020 Chinese Automation Congress (CAC)*, 1593-1598, 2020. [Link](#)

Patents

- [1] Jiaxin Liu, **Mingrui Luo**, Rui Guo, Shengchuan Li, En Li, et al.. "GIS cavity operation device and GIS cavity operation method," CN. Patent No. *ZL 2022 1 0266769.2*, 2023. [Link](#)
- [2] En Li, Aoshun Zhang, **Mingrui Luo**, Guodong Yang, et al.. "Rope-driven snakelike mechanical arm control method, device and equipment," CN. Patent No. *ZL 2021 1 1371378.9*, 2023. [Link](#)
- [3] En Li, **Mingrui Luo**, Guodong Yang, Zize Liang, Min Tan, et al.. "Depth camera vision enhancement method and system under low-illumination weak-contrast complex environment," CN. Patent No. *ZL 2020 1 1190396.2*, 2023. [Link](#)
- [4] **Mingrui Luo**, En Li, Rui Guo, Jiaxin Liu, Guodong Yang, Zize Liang, Min Tan, et al.. "Multilayer scene reconstruction and rapid segmentation method, system and device in narrow space," CN. Patent No. *ZL 2020 1 1195340.6*, 2022. [Link](#)
- [5] En Li, **Mingrui Luo**, Guodong Yang, Zize Liang, Min Tan, et al.. "Method, system and device for fusing sensing and space positioning of multiple sensors of robot," CN. Patent No. *ZL 2020 1 1190385.4*, 2022. [Link](#)
- [6] Cunfeng Kang, **Mingrui Luo**, Chunyang Shi, Donglin Chen. "Automatic color filling and abstracting method for three-order magic cube," CN. Patent No. *CN 111383352A*, 2020. [Link](#)
- [7] Jianhua Wang, Mengxuan Gao, **Mingrui Luo**, Jingxuan Shen, Tong Wu, Caixia Zhang;. "A kind of auxiliary builds the lunar rover of lunar base and lunar rock sample collection," CN. Patent No. *ZL 2019 1 0391153.6*, 2019. [Link](#)
- [8] Shuwen Sun, **Mingrui Luo**, Zhaoyang Shi, Jun Sun, Mengxuan Gao;. "A kind of automation equipment that realizing a wide range of time-lapse photography and control method," CN. Patent No. *ZL 2018 1 1136164.1*, 2018. [Link](#)
- [9] Jianhua Wang, **Mingrui Luo**, Zixiao Liu, Yuhan Xin;. "Water polo machine for automatically recovering device people," CN. Patent No. *ZL 2018 1 0457020.X*, 2018. [Link](#)

Software Copyright

- [1] "Multilevel 3D scene reconstruction and segmentation software," CN. Copyright No. *2021SR0524534*, 2021.
- [2] "Robot multi-sensor fusion perception and positioning software," CN. Copyright No. *2021SR0524533*, 2021.
- [3] "Visual Enhancement Processing Software for Narrow Environment with Weak Light," CN. Copyright No. *2021SR0588949*, 2021.
- [4] "Third level Rubik's Cube multifunctional restoration teaching platform," CN. Copyright No. *2019SR1164798*, 2019.
- [5] "A Stepping Motor Precision Control System Based on STM32," CN. Copyright No. *2019SR1172985*, 2019.
- [6] "Intelligent camera motion control software," CN. Copyright No. *2018SR878238*, 2018.
- [7] "Intelligent printing model car control software," CN. Copyright No. *2017SR685869*, 2017.
- [8] "Intelligent rainforest purifier automatic control system," CN. Copyright No. *2017SR611328*, 2017.
- [9] "Indoor positioning and mobile grabbing system for elderly robot assistance," CN. Copyright No. *2017SR611308*, 2017.

Research Projects

➤ Research and Application of Operation Robot System for Power Industry

Core Student Member

National Key Research and Development Program (2018YFB1307400)

Dec. 2019 - Mar. 2023

- Developed an inspection robot for gas-insulated switchgear in power substations. The robot consists of an **all-terrain mobile chassis**, a **multi-level lifting platform**, and a **cable-driven manipulator** with a length of 2.2 meters, 24 degrees of freedom, and a diameter of 50 millimeters.
- Participated in the **mechanism optimization of the manipulator**, which imitates the coiling behavior of snakes and can coil to reduce storage space or uncoil to expand the working range.
- Participated in the **design of the control system for the manipulator**, mainly using **CANOpen** communication and realizing 36-axis high-precision synchronous control based on **CODESYS** and **ROS**.
- Participated in the **planning algorithm design for the manipulator**, using a **follow-the-leader biomimetic strategy** and **Multi-constraint redundant inverse kinematics** to control the tip pose, meeting the needs of narrow-space obstacle avoidance operations.

➤ Research of a Narrow-space Coating Robot for Application in Aviation Manufacturing

Core Student Member

Major Enterprise Project

Sep. 2021 - Sep. 2022

- Developed a narrow-space coating robot, which consists of a **6-degree-of-freedom rigid manipulator** and a **20-degree-of-freedom flexible manipulator**.
- Participated in the **design of the control system for the robot**, using **Ethercat** as the main communication method to establish the collaboration between the rigid and flexible arms, and implemented CATIA's **digital twin interaction** through **OPC UA**.
- Participated in the **development of algorithms for seam positioning and quality assessment**, which uses **computer vision** to locate seams and provide guiding paths for the kinematic planning system, as well as evaluate the quality of the coating with the **YOLO algorithm**.

➤ Research on Environment Perception and Reconstruction for Robots in Narrow Spaces

Bachelor's Thesis, National Natural Science Foundation of China (61873267)

Nov. 2019 - Jun. 2020

- An active **brightness equalization algorithm** was developed for low-light environments using a combination of multiscale Gaussian filtering, distributed fill-light modeling, and gamma correction techniques.
- A **repair algorithm** was designed to address **point cloud data in narrow blind spots** through the utilization of spatial texture features.
- A robust algorithm for **estimating the end effector pose** of a robot was established, which fuses **visual odometry**, **encoders**, and **MARG sensors** using a **fuzzy adaptive EKF** based on a differential motion model.
- A **multi-level reconstruction method** for scenes was designed based on the **OctoMap** framework, which achieves real-time reconstruction of large-scale dynamic scenes while preserving essential details.

Awards and Honors

■ Honorary Title

Sep. 2020 - Jun. 2022

“Excellent Student” of UCAS in 2021 and 2022

Sep. 2019 - Jun. 2020

“Outstanding Graduate” of Beijing and BJUT

Sep. 2016 - Jun. 2019

“Excellent Student” of BJUT in 2017, 2018, and 2019, “Excellent Student Cadre” of BJUT in 2018

■ Scholarship

Nov. 2018

National Scholarship

Dec. 2017, Dec. 2018

Yang Shuzi Academic Scholarship in 2017 and 2018

Sep. 2016 - Dec. 2019

“Excellent Learning” and “Innovation and Entrepreneurship” Award of BJUT in 2017, 2018, and 2019

■ Contest

Nov. 2017, Nov. 2019

First Prize of the 3rd and 5th Student Extracurricular Academic Works Competition of BJUT

Jun. 2019

First Prize of the 10th Capital University Academic Science and Technology Works Competition

May. 2019

First Prize of the 2019 National College Student Mechanical Product Digital Design Competition

Feb. 2019

Honorable Mention of the 2019 American College Student Mathematical Modeling Competition

Sep. 2018

First Prize of the 2018 National College Student Mathematical Modeling Competition (Beijing Division)

May. 2018

Silver Award of the 2018 “Challenge Cup” Capital University Student Entrepreneurship Competition

Aug. 2017

First Prize of the 2017 China Robot Competition

References

- Prof. En Li
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- Prof. Min Tan
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