

# Wenshuo Li

## Curriculum Vitae

Hong Kong, China

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### Education

- 2020–2024 **Ph.D. in Mechanical Engineering**, GPA: 3.6/4, Harbin Institute of Technology, Shenzhen, China
- **Ph.D. Thesis:** *Research on Integrated Force-Position-Shape Planning and Control Methods for High-Performance Cable-Driven Hyper-Redundant Manipulators*, under supervision of **Prof. Wenfu Xu**
- 2017–2020 **M.Eng. in Mechanical Engineering**, GPA:88/100, Dalian Maritime University, Dalian, China
- **M.Sc. Thesis:** *Kinematic model and experimental study of soft manipulator under contact constraints*, under supervision of **Prof. Yinglong Chen**
- 2012–2016 **B.S. in Mechanical Engineering (specializing in Salvage Engineering)**, GPA: 81/100, Dalian Maritime University, Dalian, China

### Research Interests

- **Advanced Robotics and Intelligent Manipulation. In particular:**
  - **Kinematics and Dynamics:** Expertise in the theoretical foundations and application of kinematics and dynamics in robotic systems, with a focus on high-performance, hyper-redundant manipulators.
  - **Control Systems:** Development of advanced control algorithms for mechanical structures to enhance precision and efficiency in varied task executions, including experience with cable-driven and soft manipulators.
  - **Reinforcement Learning and VLA:** Application of reinforcement learning to robotic grasping, and exploration of vision-language-action models for task understanding, policy learning, and generalization in manipulation.
  - **Digital Twin for Robotics:** Integration of digital-twin pipelines for robot design, control validation, and deployment, including simulation-driven optimization and data synchronization between virtual and physical systems.

### Honors & Awards

- 2024 **RAS Travel Grant**, 2024 IEEE International Conference on Robotics and Automation
- 2024 **BYD Scholarship**, Awarded by BYD Company Limited to recognize outstanding graduate students in the field of automotive automation engineering
- 2021 **Guangdong Youth May Fourth Medal**, Recognized as an outstanding member of the awarded collective
- 2020–2024 **Doctoral Scholarship**, Awarded annually for outstanding academic performance and research contributions

- 2019 **SMC Enterprise Scholarship**, Awarded for academic excellence
- 2017–2020 **Master’s Scholarship**, Granted to the top 10% of the graduate student body
- 2012–2016 **Undergraduate Scholarship**, Received consecutively for ranking in the top 30% of the class each year
- 2015 **Dalian City Star Volunteer**, Recognized for outstanding volunteer service
- 2013 **Achievement in Social Responsibility Management**, Hong Kong Environmental Protection Association (HKEPA) Outstanding Award

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## Research Experiences

- 2023–2024 **Development of Joint Modules and Flexible Hand Test Modules for Long-arm Cable-driven manipulators**, Cross-disciplinary Project  
**Key Technical Member & Project Manager:**
  - Analyzed and developed the kinematic and dynamic models of the long-arm cable-driven manipulator, considering its unique structure and motion characteristics to achieve accurate model construction.
  - Designed and developed standard test objects and a comprehensive testing system for the cable-driven manipulator along with a standardized platform for testing motors, drivers, sensors, and the mechanical strength of the designed robotic structures, ensuring the universality and adaptability of the test objects and systems.
- 2021–2022 **Design of a Cable-Driven Manipulator for Charging**, Cross-disciplinary Project  
**Key Technical Member & Project Manager:**
  - Engineered a modular cable-driven robotic hand equipped with dual-level internal sensors, including joint encoders and cable tension sensors.
  - Developed a multi-space dynamic model to map the relationships between the motors, cables, joints, and end-effector states.
  - Implemented high-precision force control for human-robot interaction, integrating force-position hybrid control and admittance control techniques.
- 2018–2022 **Theoretical and Technological Research on New Variable Structure Robotic Mechanisms**, Grant No. 2018YFB1304600  
**Key Technical Member:**
  - Addressed the need for precise operations in confined spaces by developing a highly redundant, mechanically decoupled, slender, and flexible robotic system with continuous arm curvature.
  - Conducted research on "whole-arm configuration-end trajectory" synchronous planning and compliant control methods for precise operations, achieving high-precision dynamic control requirements for fine manipulations.
- 2017–2020 **Contact Constrained Motion Mechanics and Impedance Control of Flexible Hydro-Muscle Driven Underwater Soft manipulators**, NSFC Young Scientist Fund, Grant No. 51905067  
**Key Technical Member:**
  - Addressed the predictability issues and non-Hookean deformation behavior in soft robotic manipulators by proposing the use of a Neo-Hookean material model for static analysis of the soft manipulator. This included combining kinematic analyses and homogeneous transformations to accurately describe the manipulator’s spatial movements.
  - Developed a novel modeling approach to predict changes in movement, stiffness, and contact forces of the soft manipulator during grasping and collision scenarios.

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## Publications

### Journals

- Bin Liang, **Wenshuo Li\***, Boyang Lin, Lei Yan, Xueqian Wang, Wenfu Xu\*, "Hybrid Tension-Position Control of Cable-Driven Serial Manipulator to Improve Accuracy and Avoid Cable Slack and Breakage," in *IEEE/ASME Transactions on Mechatronics*, 2024. **Major contributor**
- **Wenshuo Li**, Xi Huang, Lei Yan, Hongyang Cheng, Bin Liang, and Wenfu Xu, "Force Sensing and Compliance Control for a Cable-Driven Redundant Manipulator," in *IEEE/ASME Transactions on Mechatronics*, 2024. **Major contributor**
- Yinglong Chen, **Wenshuo Li**, Yongjun Gong, "Static modeling and analysis of soft manipulator considering environment contact based on segmented constant curvature method," in *Industrial Robot: the international journal of robotics research and application*, vol. 2020. **Major contributor**
- YingLong Chen, **WenShuo Li**, Qiang Guo, YongJun Gong, "Kinematics modeling of soft manipulator interacting with environment using segmented variable curvature method," *International Journal of Control, Automation and Systems*, vol. 20, no. 1, pp. 255-267, Jan. 2022. **Major contributor**
- Junxiang Li, Wenfu Xu, **Wenshuo Li**, Lei Yan\*, Bin Liang\*, "Design and Development of Composite Linkage Mechanism for Cable-Driven Segmented Manipulator to Increase Synchronous Accuracy and Transmission Distance," in *IEEE Robotics and Automation Letters*, 2023.
- Boyang Lin, Wenfu Xu, **Wenshuo Li**, Han Yuan\*, and Bin Liang\*, "Ex-Situ Sensing Method for the End-Effector's Six-Dimensional Force and Link's Contact Force of Cable-Driven Redundant Manipulators," in *IEEE Transactions on Industrial Informatics*, 2024.
- Zhiwei Wu, Lei Yan, Wenfu Xu, **Wenshuo Li**, Bin Liang, "Coordinated base disturbance and Cartesian stiffness optimization of a cable-driven redundant space robot," in *Nonlinear Dynamics*, 2025.

### Conferences

- **Wenshuo Li**, Wenfu Xu, Peisheng Huang, Boyang Lin, Bin Liang, "Stiffness-Based Hybrid Motion/Force Control for Cable-Driven Serpentine Manipulator," in *2024 IEEE International Conference on Robotics and Automation (ICRA)*. Yokohama, Japan, 2024.
- **Wenshuo Li**, Bin Liang\*, Boyang Lin, Junxiang Li, Wenfu Xu, "Pose-Shape Unified Planning of Cable-Driven Serial Manipulators Based on Multiple Arm-Angle Construction," in *2023 IEEE International Conference on Robotics and Biomimetics (ROBIO)*, Koh Samui, Thailand, 2023.
- **Wenshuo Li**, Wenfu Xu, Boyang Lin, Lei Yan\*, "Design, Kinematics and Control of a Modular Cable-Driven Manipulator for Fine Manipulation," in *2022 IEEE International Conference on Robotics and Biomimetics (ROBIO)*, Xishuangbanna, China, 2022.

## Chinese Patents

- **Closed-loop Motion Control Method and System for a Cable-Driven Manipulator**. No. CN113386124B.
- Additional patents include methods and devices for closed-loop control, compliance control in operational spaces, and whole-arm force sensing for cable-driven manipulator, totaling **7 patents**.

## Under Review

- **Wenshuo Li**, et. al. "Integrating Morphology into Task-space: Generalized Task Planning and Optimal Control for Cable-Driven Serial Manipulators," in *IEEE/ASME Transactions on Mechatronics*.

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## Working experiences

2024.9–now **Postdoctoral Fellow**, *The University of Hong Kong (HKU)*

Research on construction robotics, including adjustment/calibration equipment and digital-twin applications for civil engineering and construction sites. Developed full-stack tools (frontend dashboards and backend services) for simulation, task monitoring, and deployment alongside robotic manipulation research.

2025.2–2025.8 **Senior Algorithm Engineer (Enterprise Postdoctoral Fellow)**, *BYD Auto Co., Ltd. (Fortune Global 500)*

Led the development of precision robotic manipulation algorithms, focusing on dual-arm coordination for complex assembly tasks. Integrated non-standard robotic arms from niche manufacturers into the ROS1 and ROS2 framework, customizing control interfaces and motion planning modules to accommodate diverse hardware specifications. Collaborated cross-functionally to deploy and optimize robotic solutions in production environments, enhancing operational efficiency and automation capabilities.

2019 **Structural R&D Intern**, *Midea (Fortune Global 500)*

Served as a **structural development engineer** in the R&D department of drinking products, participated in two projects, and was responsible for preliminary structural design and modifications. Collaborated in the development of a new product, and completed initial structural design and product feasibility analysis.

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## Scientific Activities

- Conference Reviewer: ICRA, IROS, ROBIO, ICIRA, etc.
- Journal Reviewer for TIE, TMech, RAL, etc.

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## Student Supervision

- **Teaching Assistant (Master's Coursework)**

Assisting professors or lecturers in teaching activities, including after-class tutoring, answering student questions, and assisting with laboratory work.

- **Teaching Assistant (Ph.D. Coursework) - Academic Paper Writing**

Duties involved guiding students through the nuances of academic writing, providing feedback on drafts, and helping to clarify the expectations of scholarly communication.

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## Computer skills

- **Programming Languages:** Python, C++, Matlab
- **Mechanical Design Software:** SolidWorks, AutoCAD, ProE, Creo
- **Frameworks:** Tensorflow, Keras, ROS, ROS2