

Jian Liu

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📍 Huazhong University of Science and Technology, Wuhan, Hubei, China

## Education

**Huazhong University of Science and Technology, Wuhan, China** *Sept 2023 - June 2026*

- M.Eng. in Mechanical Engineering; **Supervisor:** Prof. Sijie Yan
- **Research Areas:** Dexterous Grasping, Grasp Quality Metric
- **GPA:** 3.57/4.0; **Lab:** State Key Laboratory of Intelligent Manufacturing Equipment and Technology
- **Coursework:** Optimal Control(97), Modern CNC and Robotic Technology(96), Modern Manufacturing Process Technology(94), Operations Research(94)

**Dalian University of Technology, Dalian, China** *Sept 2018 - June 2023*

- B.Eng. in Mechanical Design, Manufacturing and Automation; **Supervisor:** Prof. Ping Zhou
- **Research Areas:** Constant-force Polishing Device Design, Tool Removal Function Modeling
- **GPA:** 3.98/5.0; **Lab:** State Key Laboratory of High-Performance Precision Manufacturing
- **Coursework:** Theory mechanics A(99), Calculus 1(99), Control engineering foundation(98), Mechanical Design 1(97), Mechanical precision design and testing technology(97)

## Research Interests

Dexterous Grasping Planning, Geometry-Based Problem Modeling, Reinforce Learning Methods

## Technologies

**Programming Languages:** Python, Matlab

**Simulation Tools:** Pybullet, ROS, IsaacGym

**Software:** Solidworks, Abaqus, AutoCAD, Cloud Compare

**Languages:** English (IELTS:Prepare, CET-6:480), Japanese (N1:104), Mandarin Chinese (native)

Academic Papers

1. **J. Liu**, S. Mao, Z. Yang, S. Yan, and H. Ding. “A Relaxed Normal Vectors-Based Contact Points Guidance Framework for Stable Dexterous Grasp”, *IEEE/ASME Transactions on Mechatronics*, (JCR Q1, IF: 7.3, Under Review).
  2. **J. Liu**, Z. Yang, L. Tang, S. Yan, and H. Ding. “Contact Driven Functional Grasp Synthesis via Hand-Object Interaction State Representation”, *International Conference on Intelligent Robotics and Applications*, (Accept, Oral Presentation).
  3. **J. Liu**. “Design of End-Effector for Robotic Polishing and Research of Polishing Process”, Bachelor’s Degree Thesis, (Outstanding Bachelor’s Thesis).

## Research Experiences

**Design and Key Technologies of Humanoid and Quadruped Robots for Parts Delivery**, Current Project for Master's Thesis  
Advisor: Prof. Sijie Yan, cooperated with postdoctor Zeyuan Yang, State Key Laboratory of Intelligent Manufacturing Equipment and Technology

- Built a **robotic arm-dexterous hand grasping system** consisting of a 6 DoF robotic arm and a 20 DoF dexterous hand. Stable grasping of multiple types of objects has been achieved through proposed **contact points guidance framework**.
- Proposed a **grasp quality metric** based on **multi-reference geometric strategy**, employing a relaxed normal vector method to overcome the limitation that existing Minkowski sum boundary theories. Compared

to the baseline scheme, our work achieves a 6-fold improvement in computational efficiency, with an error of less than 15% compared to the actual values in the computation of  $Q$  distance.

- Proposed a **grasp planning method** based on **contact points traction**, where contact points serve as an intermediate representation between the hand and the object. By employing an interactive bisection surface method and a reverse planning process, the non-inference grasp process planning is achieved, converging to the target state.

### Robotic Polishing Equipment for Surface Polishing of Optical Components      *July. 2022 - June. 2023*

Advisor: Prof. Ping Zhou, State Key Laboratory of High-Performance Precision Manufacturing

- Designed a **quasi-zero stiffness device** based on the combination of positive stiffness springs and negative stiffness flexible beams, achieving the goal of **constant-force robotic polishing**.
- Developed a **co-self rotating polishing tool** head capable of achieving a quasi-Gaussian distribution removal function, **suppressing overcutting phenomena** during continuous machining processes.
- Investigated the **influence laws of process parameters**, achieving **quantitative and localized material removal goals** based on the polishing-trimming method.

### Intelligent Collaborative Processing Theory and Methods for Large-Scale Complex Components with Multi-Robot Equipment      *Dece. 2023 - Apri. 2025*

Advisor: Prof. Sijie Yan, State Key Laboratory of Intelligent Manufacturing Equipment and Technology

- Constructed a **multi-robot measurement and processing platform** for large and complex components, completing the grinding and polishing experiments of high-speed rail car bodies.
- Participated in drafting content for national key project scientific reports, created corresponding defense PowerPoint presentations, and handled on-site defense arrangements for large-scale projects.

### Development of Efficient Robotic Grinding and Polishing Technology      *July. 2024 - Current* with Force Control Device for Composite Components

Advisor: Prof. Sijie Yan, State Key Laboratory of Intelligent Manufacturing Equipment and Technology

- Investigated the **Nurbs machining trajectory** planning scheme for composite material components.
- Designed the **grinding structure** of end effector, including a disc-type grinding structure and a belt-type grinding structure.

## Leadership Experiences & Activities

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### China College Students Mechanical Engineering Innovation and Creativity Competition, Intelligent Precision Assembly Competition

2021

- Team leader: planned and implemented a robotic assembly solution for complex precision metal blocks, which won the national first prize.

### Shushan Academic Society Student Club

2021

- Club leader: held a book-sharing event in the field of literature, served as the keynote speaker for over 20 themed reading sessions(covering topics e.g., Kazuo Ishiguro, Karen Blixen, and Latin American literature).

### University Student Self-Management Association, Publicity Department

2020

- Department leader: Participated in and guided the production of promotional materials (e.g., school welcome manuals and association brochures) in the field of graphic design, and completed the planning of events like the school carnival and annual summary meeting.

## Honors & Awards

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Scholarship for Postgraduates (top 20%), HUST	2023, 2024
Outstanding Graduate Award (Top 10%), DUT	2023
Outstanding Bachelor's Thesis Award (Top 4%), DUT	2023
Chen Yi Scholarship (Top 4%), DUT	2022