HAO WU

Email | Tel: is.wuhao.me@gmail.com | +86 17300989202 | Homepage: https://wuhao-me.github.io/

EDUCATION AND WORK EXPERIENCE

Zhejiang University — **Zhejiang, China**
B.E. in Mechanical Engineering — 2020.09 - 2024.06
Honor Class, Overall GPA: 3.98/4.0 (89.93/100)
Full-time Research Assistant (Advisor: *Prof. Huixu Dong*) — 2024.08 - 2025.09

Nanyang Technological University — **Singapore**
Summer Research Intern (Advisor: *Prof. K Jimmy Hsia, Dr. Changhong LINGHU*) — 2023.07 - 2024.09

SELECTED AWARDS AND HONORS

- **Outstanding Graduates of Zhejiang Province (<5%)** — 2024
- **Top 10 Graduation Thesis, ME, Zhejiang University** — 2024
- **Certificate of Excellence Talent Training Program** — 2024
- **Bronze Award of Graduation Design Competition (24/1139)** — 2024
- Outstanding Graduation Thesis Scholarship — 2024
- **Zhejiang Provincial Government Scholarship** — 2023
- **First Prize in the National Collegiate Mathematics Competition** — 2021-2023
- Merit Student of Zhejiang University — 2021-2023
- Excellence Award in the National College Student Mechanics Competition — 2023
- **Second-Class Scholarship for Outstanding Students of Zhejiang University** — 2021,2023
- **Bronze Award in the National College Students Innovation and Entrepreneurship Competition** — 2022
- **Second Prize in the National College Students Smart Car Competition** — 2022
- **Second Prize in the National College Students Mechanical Innovation Design Competition** — 2022
- Honorable Mention in the Mathematical Contest in Modeling — 2022
- Third-Class Scholarship for Outstanding Students of Zhejiang University — 2022
- First Prize in Zhejiang University Student Intelligent Robot Creativity Competition — 2022

RESEARCH INTERESTS

My research interests are broadly on **Robotic Design, Perception and Manipulation**, with particular interests in **the development of bioinspired robots, adaptive manipulators, and multimodal haptic sensors**. My work involves the integration of advanced materials, mechanical engineering, and sensor technology to create adaptive robotic systems capable of sophisticated interactions with their environment.

PUBLICATIONS AND PATENTS

[1] Haotian Guo*, **Hao Wu***, Yanzhe Wang*, Yaoting Xue, Tuck-Whye Wong, Tiefeng Li, and Huixu Dong†. Enabling Tunable Stiffness, Adhesive Grasping, and Interaction-driven Reconfiguration: A Shape-Memory-Polymer-Enhanced Fin-ray Gripper. Soft Robotics, 2025, **In Press**.

[2] **Hao Wu**, Zhaohui Lin, Yanzhe Wang, Haotian Guo, and Huixu Dong†. Integrating Biomimetic Synergy with Linkage-Driven Mechanisms: An Anthropomorphic Hand for Versatile Grasping and Manipulation. IEEE Robotics and Automation Letters, 2025, **Under Review**.

[3] Yanzhe Wang*, Haotian Guo*, **Hao Wu***, and Huixu Dong†, Flexible Robotic Hand Harnesses Large Deformations for Full-Coverage Human-like Multimodal Haptic Perception. Nature Communications, 2025, **In Press**.

[4] Yanzhe Wang, Wei Yu, **Hao Wu**, Haotian Guo, Huixu Dong†. SA-DEM: Dexterous Extrinsic Robotic Manipulation of Non-Graspable Objects via Stiffness-Aware Dual-Stage Reinforcement Learning. IEEE Transactions on Automation Science and Engineering, 2025, **Accepted**.

[5] **Hao Wu***, Haotian Guo*, Yanzhe Wang, Huixu Dong†. High-Speed Rotating Optics for Multi-Modal and Omnidirectional Dynamic Tactile Perception in Fingertip Sensors. IEEE Transactions on Robotics, 2025, **Preparing**.

[6] **Hao Wu***, Yanzhe Wang*, Yinuo Xu, Huixu Dong†. A Visuotactile Roller Palm for Robotic Object Manipulation and Reconstruction. IEEE Robotics and Automation Letters, 2025, **Preparing**.

[7] Yanzhe Wang*, **Hao Wu***, Huixu Dong†. Multi-Spectrally Enhanced Proprioceptive Learning for Variable-Stiffness Robotic Grasping. IEEE Robotics and Automation Letters, 2025, **Preparing**.

[8] Yanzhe Wang*, **Hao Wu***, Huixu Dong†. Visuotactile Roller Enables Tactile-Guided Scanning for Surface Defect Detection. IEEE Transactions on Instrumentation and Measurement, 2025, **Preparing**.

[9] DONG H., **WU H.**, et al., A New Type of Anthropomorphic Five-Fingered Dexterous Hand.

[10] DONG H., WANG Y., **WU H.**, GUO H., YU W., ZHANG X., XU Y., A Flexible Visual-Tactile Finger, Gripper and Manufacturing Method Based on Multi-Mirror Optical System.

[11] DONG H., ZOU Y., QIAN T., GUO H., **WU H.**, A Dexterous Finger with Cable-Driven Active Length Adjustment.

[12] WANG Y., **WU H.**, A visuotactile sensor integrated with optical waveguides and its preparation method.

[13] WANG Y., **WU H.**, A cylindrical visuotactile sensor based on an ultra-wide-angle camera.

RESEARCH EXPERIENCE

Enabling Tunable Stiffness, Adhesive Grasping, and Interaction-driven Reconfiguration: A Shape-Memory-Polymer-Enhanced Fin-ray Gripper

• Take advantage of the thermoresponsive stiffness and reversible adhesion of Shape Memory Polymers (SMPs) to augment the grasping modality in fin-ray gripper design.

• Validate the high load capacity, good shape adaptability and adhesive grasping capability with gripper successfully lifting objects of arbitrary shapes and weights, grasping large-diameter sphere, concave, planar, and tiny items.

• Actively modify the gripper's conformation with intended engagement with objects or environment and implement human-inspired strategies to manipulate tools or handle inaccessible objects.

Integrating Biomimetic Synergy with Linkage-Driven Mechanisms: An Anthropomorphic Hand for Versatile Grasping and Manipulation (Final Year Project)

• Develop an integrated linkage-driven humanoid hand with 19 joints and 11 active actuators. Novel linkage mechanisms are proposed with optimized geometric parameters to achieve dexterous movements and resemble natural human gestures.

• Perform grasping and manipulation experiments to demonstrate the hand's capability to adapt to various objects and manipulate tools for specific tasks, validating its human-like operational strategies.

Flexible Robotic Hand Harnesses Large Deformations for Full-Coverage Human-like Multimodal Haptic Perception

• Introduce the vision-based tactile sensor to the fin-ray gripper which facilitates the multimodal perception of contact force, texture, slippage, temperature, and proprioception without compromising its adaptability and flexibility.

• Optimize the positioning and orientation of mirrors with CMA-ES algorithms, ensuring that the internal camera can reliably acquire full-coverage imagery through mirror reflection even during instances of significant deformation.

• Illustrate the performance of the Tactile-integrated FlexiRay in recognizing multimodal contact information in specific grasping and operational tasks through a learning-based approach.

SA-DEM: Dexterous Extrinsic Robotic Manipulation of Non-Graspable Objects via Stiffness-Aware Dual-Stage Reinforcement Learning

• A novel dual-stage reinforcement learning method that integrates object stiffness for the first time to achieve flexible, autonomous planning for non-grasping manipulation.

• A unified 3D spatial observation representation and a consistent actor-critic framework that effectively addresses pose decision-making and action interaction in extrinsic dexterous manipulation.

• A data-driven learning strategy for the high-level agent that integrates discrete sparse action decisions into a continuous reward representation. The trained policies demonstrate exceptional perceptual decision-making capabilities and dynamic manipulation skills, enabling it to autonomously determine target poses for objects and execute diverse actions.

High-Speed Rotating Optics for Multi-Modal and Omnidirectional Dynamic Tactile Perception in Fingertip Sensors

• A rotating LED and light intensity sensor rapidly scan the conical optical waveguide, thereby acquiring omnidirectional contact information. Meanwhile, the persistence of vision can provide stable illumination for RGB camera, enabling the integration of visuotactile sensors that measure static forces with high-frequency response optical waveguide sensors.

• The fingertip sensor has multi-modal and omnidirectional perception capabilities for contact, pressure, texture, slippage, and high-frequency vibrations, thereby enabling contact-rich manipulation on dexterous hands.

Design and Application of Gecko Bio-inspired Climbing Robot Based on SMP Adhesives

• Integrate array embedded heaters with E44 epoxy Shape Memory Polymer (SMP) as smart adhesive devices to achieve precise heat transfer and rapid thermo-responsive actuation.

• Validate the potential to use the SMP R2G adhesive fibrils as a soft gripper to grip heavy and rough objects, which will further serve as the footpads of a quadrupedal robot for climbing and withstanding heavy payloads on various surfaces.

EXTRACURRICULAR ACTIVITIES & SERVICES

• Peer Reviewer: TASE, ICRA, RA-L

• Active participation in volunteer activities for over 250 hours 2020.09 - 2024.10

• Attendance at Mech Eng Global Lecture Series of Hong Kong University (Highest Score) 2021.08

• Co-found a startup aimed at addressing dysphagia in the elderly 2024.12 - 2025.10

SKILLS

- Expert at Mechanics Modeling, Finite Element Analysis, and Programming with Python, C/C++
- Experienced in Hands-on Assembly, Functional Validation, and Structural Optimization of Hardware
- Highly proficient in the Fabrication and Characterization of Soft Materials
- Comprehensive knowledge of PCB Manufacturing and MCU Controlling
- Good at MATLAB, SOLIDWORKS, Altium Designer, AutoCAD, Arduino, Keil, and ROS