HAO WU

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EDUCATION

Zhejiang University — **Zhejiang, China**
B.E. in Mechanical Engineering — 2020.09 - 2024.06
- Overall GPA: 3.98/4.0 (89.93/100)

Nanyang Technological University — **Singapore**
Summer Research Intern — 2023.07 - 2024.09

SELECTED AWARDS AND HONORS

- **Outstanding Graduates of Zhejiang Province** 2024
- **Top 10 Graduation Thesis, ME, Zhejiang University** 2024
- **Certificate of Excellence Talent Training Program** 2024
- **Bronze Award of Graduation Design Competition** 2024
- Outstanding Graduation Thesis Scholarship 2024
- **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
- Honor Prize 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 interest is broadly in **Robotic Design, Perception, and Manipulation**, with particular interests in the advancement of **biomimetic robots, soft manipulators, and 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.

RESEARCH EXPERIENCE

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

Hao Wu*, Haotian Guo*, Yanzhe Wang*, Yaoting Xue, Tuck-Whye Wong, Tiefeng Li, and Huixu Dong†

Soft Robotics (Under Review) 2024.05 - 2024.10

- 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 (Graduation Thesis)

Hao Wu*, Zhaohui Lin, Haotian Guo, and Huixu Dong†

RA-L (Under Review) 2023.10 - 2024.11

- Conduct biomechanical analysis of human hand synergistic movements to provide reasonable simplifications of its intricate and compact nature.
- Develop an integrated linkage-driven anthropomorphic hand featuring 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.

Tactile-integrated FlexiRay: Breaking Planar Limits by Harnessing Large Deformations for Flexible, Full-Coverage, Human-like Multimodal Sensing

Hao Wu*, Yanzhe Wang*, Haotian Guo*, and Huixu Dong†
Nature Communications (Under Review) 2024.06 - 2024.12

• 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.

Development of a Tendon-Driven Dexterous Hand with Variable Length Ability for Advanced Manipulation and Rehabilitation Applications (In Progress)
Advisors: **Prof. Huixu Dong** 2024.07 -

• Design a tendon-driven dexterous finger with rolling joints capable of bidirectional movements and length adjustment.
• Establish kinematic and static models to characterize the finger's motion, facilitating precise control and actuation.
• Conduct experiments to validate the feasibility of the finger as a component in the dexterous hand, rehabilitation exoskeleton, and sensor glove.

Design and Application of Gecko Bio-inspired Climbing Robot Based on SMP Adhesives (In Progress)
Advisors: **Prof. K Jimmy Hsia, Dr. Changhong LINGHU** 2023.07 - 2023.09

• 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.

Self-Motivated/Contest Projects

• Replicate the appearance and locomotion of spiders and develop a **Hexapod Robot** that facilitates diverse movements on various road surfaces through the integration of 18 servomotors and 3D-printed components.
• Accomplish the mechanical fabrication of a 13-DOF **Bipedal Robot** and achieve motion control with simple gaits.
• Develop a **Rubik's Cube Robot** capable of automatically recognizing individual color blocks and solving for the solutions, consequently using six stepper motors to restore the cube within seconds.
• Construct the hardware and software platform for an **Underwater Vehicle**. My work involves structural design, modeling and simulation, manufacture and assembly, sensor integration, remote control, and underwater validation.

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
• Leader of the Student Quality Training Project of Zhejiang University 2021.04 - 2021.10

SKILLS

- Expert at Mechanics Modeling, Finite Element Analysis, 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

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