

Zhefeng Huang

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RESEARCH INTERESTS

Robot learning, world models, vision-language-action models, task and motion planning, robot manipulation, and medical and surgical robotics.

EDUCATION

Georgia Institute of Technology

Aug 2022 – Present

Ph.D. in Robotics, Atlanta, GA, USA - Expected Summer 2027

Advisor: Prof. Yue Chen

- GPA: 4.00/4.00; passed the Robotics Ph.D. Qualifying Examination.

Tsinghua University

Sep 2018 - Jun 2022

B.S. in Mechanical Engineering (Elite Program), Beijing, China

- Major GPA: 3.83/4.00; Minor in Computer Technology and Applications, GPA: 3.94/4.00.

RESEARCH EXPERIENCE

World-Model-Augmented VLA for Long-Horizon Surgical Manipulation

Jun 2026 - Present

Georgia Institute of Technology, Atlanta, GA

- Developing vision-language-action policies augmented with future-predictive latent world models for long-horizon surgical manipulation.
- Learning predictive state representations from mixed-quality expert and non-expert interaction data.

Flow-Matching World Model for Robot Manipulation Failure Detection

Feb 2026 - Jul 2026

Georgia Institute of Technology, Atlanta, GA

- Developed an action-conditioned flow-matching latent world model to detect low-level execution failures using only successful training data.
- Compared expected and observed visual dynamics through inverse latent transport and calibrated operational thresholds with conformal prediction.
- Built simulation and real-world da Vinci Research Kit pipelines for data collection, imitation learning, and evaluation.

Self-Reconfiguration Planning for Continuum Modular Robot System

Apr 2025 - Jan 2026

Georgia Institute of Technology, Atlanta, GA

- Developed geometric and topological representations of planar continuum modular robots using combinatorial topology.
- Formulated self-reconfiguration as task and motion planning over configuration manifolds; proposed HEART-MCTS and integrated Atlas-RRT*.
- Developed a graph neural network representation of modular robot morphology.

Mobile Nursing Robot in an Intensive Care Unit

Apr 2024 - Oct 2024

Georgia Institute of Technology / Emory Decatur Hospital, Atlanta, GA

- Developed a customized teleoperation interface for a Stretch 2 mobile manipulator and conducted teleoperated demonstrations in an ICU ward.
- Conducted a human-robot interaction study of nurses' perceptions and acceptance of mobile nursing robots.

Ultrasound-Guided Robotic Needle Insertion

Sep 2023 - Jan 2024

Georgia Institute of Technology, Atlanta, GA

- Developed a dual-arm robotic needle insertion system using a Franka Research 3 arm and ultrasound guidance.
- Built an XY motion platform to emulate respiratory motion and performed insertions during relative target quiescence.

Development of a Body-Mounted MR-Conditional Medical Robot

Jan 2023 - Sep 2023

Georgia Institute of Technology, Atlanta, GA

- Designed, fabricated, and integrated a four-degree-of-freedom body-mounted MR-conditional robot with a two-layer positioning structure and pneumatic actuation.
- Developed the mechatronic control system and evaluated robot kinematics, workspace, and targeting performance.

Geometric Modeling and Optimization of Concentric Tube Robots

Sep 2022 - Jan 2023

Georgia Institute of Technology, Atlanta, GA

- Developed parameterized helical models and optimization methods for concentric-tube robot design under anatomical constraints for intracerebral hemorrhage evacuation.

PROFESSIONAL EXPERIENCE

Mechanical Engineering Intern

Jun 2021 - Aug 2021

Ericsson, Beijing, China

- Developed a Microsoft Excel add-in to streamline tolerance-analysis workflows; the tool was adopted by the mechanical design team.

- Investigated airflow-induced vibration and noise of heat-sink fins in outdoor telecom base stations through coupled fluid-structure-acoustic simulation and wind-tunnel testing; proposed design modifications to reduce wind noise.

SELECTED TECHNICAL PROJECTS

Procedural Trees and Creatures – Course Project, CS 8803: Procedural Content Generation Fall 2024

- Implemented classic procedural content generation algorithms in C# using Unity.
- Created randomized tree-growth systems with controllable branching, tropism, leaf placement, age-dependent growth, and obstacle-aware generation.
- Generated continuous creature meshes using Marching Cubes with shared vertices for smooth normals and color transitions, together with randomized morphology and accessories.

Local MCTS Motion Planning - Robotics Ph.D. Qualifying Examination Project May 2024

- Implemented a Monte Carlo tree search local planner for a non-holonomic mobile robot navigating among passively deformable obstacles.
- Enabled the robot to push an obstacle within its deformation limit, proceed when a path opened, or retreat and replan when continued interaction was infeasible.

PUBLICATIONS

Preprint and Manuscript Under Review

1. **Zhefeng Huang**, Yilin Cai, Ankit Patel, Mohammad Hajiha, Brendan Browne, and Yue Chen. “Failure Detection for Surgical Robot Imitation Policies via Flow-Matching World Modeling.” *arXiv preprint arXiv:2607.27511*, 2026. Submitted to IEEE Robotics and Automation Letters (RA-L).

Peer-Reviewed Journal Articles

2. Yilin Cai*, **Zhefeng Huang***, Yifan Wang, Haokai Xu, and Yue Chen. “Evolutionary Diversification via Modular Compliance for Self-Reconfigurable Continuum Robots.” *Science Advances* 12, eaeg9191, 2026. *Equal contribution.
3. **Zhefeng Huang**, Anthony L. Gunderman, Samuel E. Wilcox, Saikat Sengupta, Jay Shah, Aiming Lu, David Woodrum, and Yue Chen. “Body-Mounted MR-Conditional Robot for Minimally Invasive Liver Intervention.” *Annals of Biomedical Engineering* 52(8), 2024, pp. 2065-2075.
4. **Zhefeng Huang**, Hussain Alkhars, Anthony Gunderman, Dimitri Sigounas, Kevin Cleary, and Yue Chen. “Optimal Concentric Tube Robot Design for Safe Intracerebral Hemorrhage Removal.” *Journal of Mechanisms and Robotics* 16(8), 2024.
5. Anthony L. Gunderman, Saikat Sengupta, **Zhefeng Huang**, Dimitri Sigounas, Chima Oluigbo, Isuru S. Godage, Kevin Cleary, and Yue Chen. “Towards MR-Guided Robotic Intracerebral Hemorrhage Evacuation: Aiming Device Design and Ex Vivo Ovine Head Trial.” *IEEE Transactions on Medical Robotics and Bionics*, 2024.
6. Samuel E. Wilcox, **Zhefeng Huang**, Jay Shah, Xiaofeng Yang, and Yue Chen. “Respiration-Induced Organ Motion Compensation: A Review.” *Annals of Biomedical Engineering* 53(2), 2025, pp. 271-283.

Conference Proceedings

7. Joseph Sommer, Anthony L. Gunderman, Saikat Sengupta, **Zhefeng Huang**, Dimitri Sigounas, Kevin Cleary, and Yue Chen. “Concentric Tube Robot-Based Intracerebral Hemorrhage Evacuation in Ex Vivo Sheep Head: A Comparative Study.” In *2024 International Symposium on Medical Robotics (ISMR)*, pp. 1-7, IEEE, 2024.

TECHNICAL SKILLS

Robot Learning & AI: Imitation learning, world models, vision-language-action models, flow matching, computer vision
Planning & Robotics: Task and motion planning, MCTS, sampling-based motion planning, robot kinematics, manipulation
Programming & Frameworks: Python, C++, C, MATLAB, PyTorch, ROS 2, Isaac Sim, OpenCV, MuJoCo, Unity
Robots & Engineering: da Vinci Research Kit, Franka Research 3, Stretch 2, SolidWorks, ANSYS, COMSOL

AWARDS AND HONORS

Outstanding Graduate, Tsinghua University	Jun 2022
Tang Lixin Scholarship (Comprehensive Excellence), Tsinghua University	Sep 2021
Academic Excellence Scholarship, Tsinghua University	Sep 2020

LEADERSHIP AND ATHLETICS

Vice Captain, Tsinghua University Student Track and Field Team	2020 - 2021
Three-Time Men’s Group A High Jump Champion, 62nd-64th Ma John Cup	2019 - 2021