Haoying (Jack) Zhou

Robotic Engineer (Systems, Software, Simulation, Control) | **Applied Scientist** | **Robotics PhD Candidate**
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Summary

Final-year PhD candidate (**Expected to graduate in May 2026**) in Robotics Engineering, specializing in surgical robotics (**dVRK, the da Vinci Research Kit**), with a strong background in long-horizon R&D: from **robot infrastructure development**, **robot system identification** and **system integration** to **simulation**, **multi-modal data collection & analysis** and **AI-driven perception & automation**. **Practical robotic problem solver for both hardware and software**.
Open to relocation inside the U.S.. Target for **Full-Time positions starting May/June 2026**. **Require F1-OPT/H-1B or equivalent visa sponsorship**.

Technical Skills

Programming Languages: Python, MATLAB, C/C++, Bash/Shell

Simulation & Visualization: AMBF (Bullet Physics), Blender, Gazebo/RViz, 3D Slicer, V-REP, NVIDIA Isaac Sim, Simulink, Ansys FEA

Robotics: ROS/ROS2, model-based robotics (kinematics/dynamics/control), system identification, teleoperation, calibration

Platform & Infrastructure: dVRK Classic/Si (5+ YoE), Linux, Git, Image pipeline (v4l2, udev), PyQt, CMake/catkin/colcon, Docker

Machine Learning & AI: PyTorch, OpenCV, Computer Vision, Deep Learning, Imitation Learning

Design & Manufacturing: Rapid Prototyping, SolidWorks, 3D Printing, Machine Shop, AutoCAD

Education

Worcester Polytechnic Institute — Worcester, MA
Ph.D. in Robotics Engineering, GPA: 3.95/4.0 — *Sep 2020 – May 2026 (Expected)*
•**Additional Training**: Laboratory Animal Surgery, IRB, Radiation and MRI safety certified

Boston University — Boston, MA
M.S. in Mechanical Engineering, GPA: 3.78/4.0 — *Sep 2018 – May 2020*

University of California, Berkeley — Berkeley, CA
Senior-year Visiting Undergraduate Student in Mechanical Engineering, GPA 3.95/4.0 — *Aug 2017 – May 2018*

Beijing Institute of Technology — Beijing, China
B.S. in Mechanical Engineering — *Sep 2014 – May 2018*

Professional Experience

Visiting Graduate Scholar — June 2023 – Present
Johns Hopkins University — *Baltimore, MD*

- Develop infrastructures to be shared with the dVRK community
- Develop high-fidelity simulation environments for NSF AccelNet Surgical Robotics Challenges in AMBF simulator and NVIDIA Omniverse Isaac Sim, utilized by 50+ international participants.
- Conduct advanced AI research utilizing the physical dVRK and simulation environments for surgical robotics applications
- Led International Conference Workshop live demonstrations in 2024 ISMR

Image-Guided Therapy Robotics Intern — May 2022 – Aug 2022
Philips Research North America — *Cambridge, MA*

- Developed robot motion simulator using DICOM and PyQt5, improving refreshing frequency by 30 times
- Integrated the Xbox game controller as an alternative control input, enabling teleoperation testing

Selected Research Projects

Multi-Modal Data Collection and Preprocessing Framework — Sep 2024 – Present
Johns Hopkins University

- Lead and manage 8-person cross-functional team building time-synchronized multi-modal data collection and preprocessing pipeline, delivering IRB-compliant data collection and analysis (1000+ ex-vivo trajectories to NVIDIA Open-H-Embodiment effort)

• Lead and mentor development of multi-threaded C++ synchronized recorders, integrating stereo endoscopy, side-view video, custom sensors and robotic kinematics across 20+ ROS topics within millisecond-level time synchronization

• Design and implement a custom capacitive contact sensor using Arduino to acquire the ground truth of tool-tissue contact

• Integrate a modern chip-on-tip endoscope with dVRK-Si, enabling seamless teleoperation and high-quality image data acquisition

• Develop PyQt5 annotation tool, kinematic reprojection pipeline using hand-eye calibration and AI-driven preprocessing framework (FoundationStereo, RAFT, SAM2), generating high-level features for AI applications

• Employ invisible UV-fluorescent paints for key-point ground truth annotation

Surgical Robot Dynamic Model Identification and Control Nov 2022 – Present

Johns Hopkins University

• Develop a novel hybrid force estimation method for the dVRK Patient Side Manipulator (PSM) under trocar interaction combining the model-based approach and the learning-based approaches, reducing the estimation errors by 30%

• Implement gravity compensation based on dynamic model identification of dVRK-Si Patient Side Manipulator (PSM) using convex optimization approaches in Python, reducing the static control errors by 73%

• Design and implement PID control, feedforward compensation, and model-based control using Lagrangian dynamics with SymPy symbolic computation and CVXPY & pyOpt convex optimization on the physical dVRK-Si PSM

Digital Twin for Suturing Scenes Feb 2022 – Present

Johns Hopkins University

• Develop high-fidelity environments with realistic dynamic feedback for suturing execution on an open-source 3D simulation platform (AMBF), utilized for NSF AccelNet Surgical Robotics Challenges and policy training data collection & benchmarking

• Scan the real-world suturing training phantoms using MRI and import the segmented 3D models into the simulation environment

• Build photorealistic dVRK surgical instrument simulation models from CADs, sharing the models with the dVRK community

• Construct high-fidelity digital twin for suturing scenes in NVIDIA Omniverse Isaac Sim

AI-driven Perception and Automation Application in Digital Twin Sep 2021 – Jun 2025

Johns Hopkins University

• Implement imitation learning algorithms for suturing automation in simulation, achieving 95% success rate for task completion, task generality on the order of 91.5% and 20% less task execution time

• Develop a novel pipeline for synchronized data collection and conduct user study for human demonstration acquisition on the digital twin (simulation) using the physical dVRK Master Tool Manipulator (MTM) as the teleoperation interface

• Develop a novel deep learning approach for real-time markerless suturing needle 6D pose estimation in simulation, achieving average errors of 1.4 mm and 2.9 degrees

Surgical Robot Infrastructure Development Mar 2021 – Present

Research Technician *Worcester Polytechnic Institute*

• Brought a full da Vinci Surgical System from non-functional state to operational using the dVRK controllers, performing calibration & validation procedures, configuring dVRK controllers and enabling full teleoperation capability

• Diagnosed and resolved critical system failures (encoder malfunction, brake defects) through systematic investigation (failure mode analysis); determined root cause, proposed design improvements, and provided feasible solutions

• Owned a novel approach for surgical instrument lubrication and instrument internal cable tension recovery

• Developed a replacement solution for the dVRK viewer console monitors and re-enabled the height adjustment linear actuator

• Developed the video pipeline for endoscope image stacks using Video for Linux v2 drivers, sharing with the dVRK community

Surgical Robotics System Integration Jan 2022 – Jun 2025

Worcester Polytechnic Institute

• Integrated custom sensors (sEMG electrodes, haptic devices) or customized end-effectors (photo-acoustic probe) with servo control algorithm and teleoperation systems for dVRK PSM

• Developed the synchronized autonomous scanning system using ROS communication for photo-acoustic probe image overlay

• Enabled teleoperation for dVRK PSMs with multiple common haptic devices, such as Phantom Omni and Razer Hydra controller, which were subsequently utilized in a dVRK-based AR measurement system

Selected Publications (15 of 18 Total)

1. **Zhou, H.***, Liu, C.*, Wu, Y., ..., & Kazanzides, P. (2026, under review). "SurgSync: Time-Synchronized Multi-modal Data Collection Framework and Dataset for Surgical Robotics." In *IEEE Intl. Conf. on Robotics and Automation (ICRA)*.
2. **Zhou, H.**, Yang, H., Deguet, A., ..., & Kazanzides, P. (2025). "Gravity Compensation of the dVRK-Si Patient Side Manipulator based on Dynamic Model Identification." In *Hamlyn Symp. on Medical Robotics (Oral)*.
3. Yang, H., **Zhou, H.**, Fischer, G. S., & Wu, J. Y. (2024). "A Hybrid Model and Learning-Based Force Estimation Framework for Surgical Robots." In *IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS)*.

4. **Zhou, H.**, Jiang, Y., Gao, S., ..., & Fischer, G. S. (2024). "Suturing Tasks Automation Based on Skills Learned From Demonstrations: A Simulation Study." In *Intl. Symp. on Medical Robotics (ISMR)*, IEEE.
5. Wu, J., **Zhou, H.**, Kazanzides, P., Munawar, A., & Liu, A.(2024). "SurgicAI: A Hierarchical Platform for Fine-Grained Surgical Policy Learning and Benchmarking." In *Conf. on Neural Information Processing Systems (NeurIPS) Datasets and Benchmarks Track*.
6. Lin, F.*, Liu, H.*, **Zhou, H.***, Hou, S.*, Yamada, K. D., ... & Zhang, Z. (2024). "Loss Distillation via Gradient Matching for Point Cloud Completion with Weighted Chamfer Distance." In *IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS)*.
7. Kim, T. W., **Zhou, H.**, Barragan, J. A., ...,& Munawar, A.(2025). "Surgical Robotics Environment in NVIDIA Isaac Sim for Robot-Assisted Suturing." In *Intl. Symp. on Medical Robotics (ISMR)*, IEEE.
8. Allison, C. J., **Zhou, H.**, Munawar, A., Kazanzides, P., & Barragan, J. A. (2024). "FIRE-3DV: Framework-Independent Rendering Engine for 3D Graphics Using Vulkan." In *IEEE Intl. Conf. on Robotic Computing (IRC)*.
9. Barragan, J. A., Zhang, J., **Zhou, H.**, Munawar, A., & Kazanzides, P. (2024). "Realistic Data Generation for 6D Pose Estimation of Surgical Instruments." In *IEEE Intl. Conf. on Robotics and Automation (ICRA)*.
10. Jiang, Y., **Zhou, H.**, & Fischer, G. S. (2023). "Development and Evaluation of a Markerless 6 DOF Pose Tracking Method for a Suture Needle from a Robotic Endoscope." *Journal of Medical Robotics Research*.
11. Wu, Z., Schmidt, A., Moore, R., **Zhou, H.**, ..., & Salcudean, S. E. (2025). "SurgPose: a Dataset for Articulated Robotic Surgical Tool Pose Estimation and Tracking." In *IEEE Intl. Conf. on Robotics and Automation (ICRA)*.
12. Yang, K., Meier, T. B., **Zhou, H.**, Fischer, G. S., & Nycz, C. J. (2022). "A sEMG Proportional Control for the Gripper of Patient Side Manipulator in da Vinci Surgical System." In *Intl. Conf. of the IEEE Engineering in Medicine & Biology Society (EMBC)*
13. Gao, S., Wang, Y., Ma, X., **Zhou, H.**, Jiang, Y., Yang, K., ... & Zhang, H. K. (2023). "Intraoperative laparoscopic photoacoustic image guidance system in the da Vinci surgical system." *Biomedical optics express*.
14. Wang, S.*, Wang, J.F.*, Koh, Y.*, **Zhou, H.**, ...,& Kazanzides, P.(2025). "An Augmented Reality Measurement Tool for the da Vinci Research Kit." In *Intl. Symp. on Medical Robotics (ISMR)*, IEEE.
15. Goldfarb, N., **Zhou, H.**, Bales, C., & Fischer, G. S. (2021). "Control of a lower limb exoskeleton using Learning from Demonstration and an iterative Linear Quadratic Regulator Controller: A simulation study." In *Intl. Conf. of the IEEE Engineering in Medicine & Biology Society (EMBC)*.

Award & Certifications

- Dr. Glenn Yee Graduate Student Tuition Award - Worcester Polytechnic Institute, Fall 2024, Spring 2025 and Spring 2026
- Dr. Glenn Yee Graduate Student Travel Award - Worcester Polytechnic Institute, Spring 2024
- CITI Program Training - Social & Behavioral Research- Johns Hopkins University
- CITI Program Training - Human Subjects in Biomedical Research - Worcester Polytechnic Institute
- Radiation Safety Training - Johns Hopkins University, Worcester Polytechnic Institute
- MRI Safety Training - Worcester Polytechnic Institute