Haoying (Jack) Zhou

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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, dynamic model identification and system integration to simulation, multi-modal learning & analysis and AI-driven perception & automation. Practical robotic problem solver for both hardware and software. **Open to relocation inside the U.S.**. **Require F1-OPT/H-1B or equivalent sponsorship**. Target for **Full-Time positions starting May 2026**.

Technical Skills

Programming Languages: Python, MATLAB, C/C++, ROS/ROS 2, bash and shell scripting

Simulation: AMBF (Bullet Physics), Blender 3D, Slicer, V-REP, Gazebo, Rviz, NVIDIA Isaac Sim, VTK, ITK, VMTK, Simulink, Ansys FEA

Platform & Frameworks: dVRK Classic/Si, Magic Leap 1, NVIDIA Clara AGX, Git, Linux, PyTorch, TensorFlow, PyQt, Docker/NGC

Design & Manufacturing: SolidWorks, Auto CAD, 3D Printing, Machine Shop Experience, Rapid Prototyping

Education

Worcester Polytechnic Institute — Worcester, MA
Ph.D. in Robotics Engineering, GPA: 3.95/4.0 — *Sep 2020 – May 2026 (Expected)*

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
- Conduct advanced 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 a robot motion simulator using raw DICOM input and PyQt 5, improving refreshing frequency by 30 times
- Integrated the Xbox game controller into the simulator as an alternative control input
- Performed analytical analysis on the simulator-generated data

Research Projects

Multi-Modal Data Collection and Contact Detection — Sep 2024 – Present
Publication 1 — *Johns Hopkins University*

- Investigate surgical robot tool-tissue contact detection using a multi-modal deep learning approach (Multi-Scale ViT + Mamba)
- Lead and manage 8-person cross-functional team, deliver IRB-compliant data collection and analysis that accelerated publication timeline and demo readiness
- Build time-synchronized multi-modal data collection pipeline (vision + kinematics + sensor) and large (100+ trajectories) ex-vivo dataset, enabling a novel kinematic projection approach and downstream optical flow/depth estimation using deep learning
- Design and implement a custom capacitive contact sensor to obtain the ground truth of tool-tissue contact
- Integrate a modern endoscope with the dVRK seamlessly, enabling high-quality image data acquisition

• Design a novel data annotation application with graphic user interface using PyQt for manual label annotations
• The data collection pipeline has been employed for efforts on Open-H-Embodiment

Surgical Robot Dynamic Model Identification and Control Nov 2022 – Present
Publication 2, 3 *Johns Hopkins University*
• Develop a novel force estimation approach for the robot under trocar interaction using a hybrid model combined the model-based approach and the learning-based approach, reducing the estimation errors by 30%
• Implement the dynamic model identification and gravity compensation of dVRK Class/Si Patient Side Manipulator using convex optimization approaches, reducing the static control errors by 73%

Digital Twin for Suturing Scenes Feb 2022 – Present
Publication 5, 6, 7, 8 *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 2021-2022 & 2023-2024 AccelNet Surgical Robotics Challenges
• 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, sharing the models with the dVRK community
• Construct high-fidelity digital twin for suturing scenes in NVIDIA Omniverse Issac Sim
• Implement Vulkan graphic engine to improve the AMBF simulation quality, reducing the rendering time by 84%

Suturing Automation with Robot Learning Sep 2021 – Feb 2025
Publication 4, 5 *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 using the physical dVRK, which is subsequently utilized for building a 2024 NeurIPS-published dataset to support surgical policy learning

Surgical Instruments Tracking and Pose Estimation Feb 2022 – May 2025
Publication 8, 9, 10, 11 *Johns Hopkins University*
• Develop a novel deep learning approach for real-time markerless suturing needle 6D pose estimation in simulation, achieving average errors of 1.76 mm and 8.55 degrees
• Develop an autonomous synthetic data generation pipeline using the high-fidelity simulation environment in the AMBF simulator
• Employ invisible UV/IR dye for ground truth labeling, which is subsequently utilized to construct a novel dataset for markerless dVRK surgical instruments pose estimation and tracking

Surgical Robot Infrastructure Development Mar 2021 – Present
Research Technician *Worcester Polytechnic Institute*
• Reactivated the full da Vinci Surgical Systems using the dVRK controllers and software
• Developed novel replacement solutions for defective joint encoders and brakes of the dVRK arms
• 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

Point Cloud Completion May 2023 – Feb 2024
Publication 12 *Worcester Polytechnic Institute*
• Proposed a novel chamfer distance loss function for point cloud completion task
• Achieved new state-of-the-art results on some benchmark dataset

Surgical Robotics System Integration Jan 2022 – Present
Publication 13, 14, 15, 16 *Worcester Polytechnic Institute*
• Developed a novel teleoperation approach using sEMG biofeedback signals
• Integrated a photo-acoustic probe with a dVRK instrument and installed on the dVRK Patient Side Manipulator (PSM)
• Constructed the kinematic model for the custom instrument to enable teleoperation and script-based control
• Developed the synchronized autonomous scanning system using ROS communication for 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

Lower-Limb Exoskeleton Walking Strategy Learning Sep 2020 – Mar 2021
Publication 17 *Worcester Polytechnic Institute*
• Developed an automated walking strategy for lower-limb exoskeleton in simulation using imitation learning approach
• Implemented Iterative Linear Quadratic Regulator to find the optimal weight matrix for control

Reaching-to-Grasping Task Automation with Robot Learning Oct 2018 – May 2020
Boston University
• Developed an automation algorithm for reaching-to-grasping task in V-REP simulation using imitation learning approach
• Leveraged joystick for the Baxter Robot end-effector control and human demonstration data collection

Selected Course Projects

Visual Inertial Odometry with Multi-Scale Constraint Kalman Filter	Worcester Polytechnic Institute
FaceSwap and Neural Radiance Fields (NeRF) Implementation	Worcester Polytechnic Institute
Adaptive Robustness Control Design for UAV with ROS Gazebo	Worcester Polytechnic Institute
Laboratory Animal Surgery	Worcester Polytechnic Institute
Autonomous Racing Car Dynamic and Control Design	University of California, Berkeley
Real-Time Bubble Recognition	University of California, Berkeley
Object Tracking Mechatronics System Design and Manufacturing	University of California, Berkeley

Publications

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*.
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. 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.
7. 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)*.
8. 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)*.
9. Jiang, Y., **Zhou, H.**, & Fischer, G. S. (2023). "Markerless suture needle tracking from a robotic endoscope based on deep learning." In *Intl. Symp. on Medical Robotics (ISMR)*, IEEE.
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. 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)*.
13. 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)*
14. Gao, S., Wang, Y., **Zhou, H.**, Yang, K., Jiang, Y., Lu, L., ... & Zhang, H. K. (2023). "Laparoscopic photoacoustic imaging system integrated with the da Vinci surgical system." In *Medical Imaging: Image-Guided Procedures, Robotic Interventions, and Modeling*, SPIE.
15. 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*.
16. 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.
17. 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 and Spring 2025
- 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