

Han Zhang

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RESEARCH INTERESTS

My primary goal is to leverage advancements in surgical robotics and mixed-reality interfaces to revolutionize interventional care, ensuring a more precise, interactive, and patient-centric approach to medical procedures. In pursuit of this ambition, my research delves deep into the amalgamation of augmented reality/virtual reality (AR/VR) and human-robot interaction. This synergy holds the promise of not just enhanced procedural accuracy but also a heightened collaboration between humans and robots in medical and healthcare settings.

EDUCATION

The Johns Hopkins University	Aug. 2022 – Dec. 2023
Master of Science; Biomedical Engineering	
● GPA: 3.80 / 4.0	
University of California, Davis	Sept. 2018 – Jun. 2022
Bachelor of Science; Biomedical Engineering with <u>Honors</u>	
● GPA: 3.79 / 4.0	

RESEARCH EXPERIENCE

Advanced Robotics and Computationally Augmented Environments Lab		
Position: Research Assistant	PI: Prof. Mathias Unberath	Time: Jan. 2023 – Present
Cardiac Signaling Laboratory at University of California, Davis		
Position: Research Assistant	PI: Prof. Ye Chen-Izu	Time: Jan. 2021- Jun. 2022
Surgical Bioengineering Laboratory at University of California, Davis Health		
Position: Research Assistant	PI: Prof. Aijun Wang & Prof. Diana Farmer	Time: Apr. 2021- Sept. 2021

PUBLICATIONS

- **H. Zhang**, Jan U. Bartels and Jeremy D. Brown, 3D Hapkit: A Low-Cost, Open-Source, 3-DOF Haptic Device Based on the Delta Parallel Mechanism. Work in Progress Paper, 2023 IEEE World Haptics Conference (WHC), July 10-13 2023, Delft, Netherlands
- B. D. Killeen, **H. Zhang**, J. Mangulabnan, M. Armand, R.H. Taylor, G. Osgood, and M. Unberath, Pelphix: Surgical Phase Recognition from X-ray Images in Percutaneous Pelvic Fixation. International Conference on Medical Image Computing and Computer-Assisted Intervention 2023 (MICCAI 2023). arXiv:2304.09285.
- B. D. Killeen*, **H. Zhang***, L. Wang, Z. Liu, R.H. Taylor, G. Osgood, and M. Unberath, Stand in My Shoes: Fostering Empathy and Engagement among Surgical Teams through Virtual Reality. The 15th International Conference on Information Processing in Computer-Assisted Interventions (**In Preparation**).

* Equal Contribution

PROJECTS

Room-level Digital Twins for Training Nurses in Virtual Reality	
Advisor: Prof. Mathias Unberath & Prof. Vinciya Pandian	Time: July. 2023 – Present
● Responsible for cooperating with nurses and developing the virtual reality MICU training environment for Central Line-associated Bloodstream Infection.	
Autonomous X-ray Image Acquisition and Interpretation System for Percutaneous Pelvic Fracture fixation	
Advisor: Prof. Mathias Unberath	Time: July. 2023 – Present
● Assisted with the design, implementation, and construction of an AR-compatible drill attachment for guiding wire insertion based on the autonomous system.	
Stand in My Shoes: Fostering Empathy and Engagement among Surgical Teams through Virtual Reality	
Advisor: Prof. Mathias Unberath	Time: Jun. 2023 – Sept. 2023
● Investigating effect of VR training on operational empathy in surgical teamwork.	
● Responsible for implementing study design, conducting user studies, and data management.	
● Working on first-authored manuscript for International Conference on Information Processing in Computer-	

Assisted Interventions (IPCAI 2024).

PelvisVR: Recreating Pelvic Trauma Surgery in Virtual Reality

Advisor: [Prof. Russell H. Taylor](#) & Prof. Mathias Unberath

Time: Jan. 2023 – Jun. 2023

- Developed an immersive and interactive virtual environment for training operating room personnel.
- Responsible for creating digital assets, implementing user interactions, multiplayer communications, and modeling tool-to-tissue interactions.
- Presented live demonstration to users at JHU LCSR Industry Day 2023, CIS Poster Day, and informal events.
- This work was featured in [NSF CAREER Award #2239077](#) and [LINK Award](#).

Learning Assessment in XR Using Eye Tracking

Advisor: [Prof. Ehsan Azimi](#)

Time: Feb. 2023 - Jun. 2023

- Developed an objective, immediate, and automatic evaluation system for trainee surgical skills.
- Responsible for implementing Unity scene, user data collection and study design.

Surgical Phase Recognition from X-ray Images in Percutaneous Pelvic Fixation

Advisor: Prof. Mathias Unberath

Time: Jan. 2023 – Mar. 2023

- Developed surgical phase recognition model for X-ray-guided percutaneous pelvic fracture fixation based on AI-generated data.
- Responsible for data collection, analysis, annotation, modeling and paper writing.
- Early accepted in MICCAI 2023.

3D Hapkit: 3-degree-of-freedom (DOF) Haptic Device using a Delta Parallel Mechanism

Advisor: [Prof. Jeremy Brown](#)

Time: Jun. 2022 - Dec. 2022

- Developed an open-source 3-DOF haptic device by rapid prototype techniques for educational purposes.
- First authored and demoed at IEEE World Haptics 2023.

Radiolucent Hand and Wrist Fixation Device for Intraoperative Fluoroscopy

Advisor: [Prof. Robert M. Szabo](#)

Time: Sept. 2021- Jun. 2022

- Developed a device that stabilized patients' upper extremities during C-arm fluoroscopy to prevent surgeons' hands from radiation exposure.
- Responsible for design, simulation, and manufacture of the device.
- Presented the 2022 UC Davis College of Engineering Design Showcase and Senior Design Symposium.
- Showcased as a model example for future students, highlighting exceptional design and documentation skills.
- Won "Excellence in Manufacturing Award" in undergraduate senior design.

Low-Cost Microfluidic Device for Microfluidic Device for Single-Cell Isolation and Cloning

Advisor: [Prof. Marc T. Facciotti](#)

Time: Sept. 2021- Jun. 2022

- Recruited and Lead 10 people to create cost-effective microfluidic chips for high throughput single cell isolation and culturing to analyze cell heterogeneity.
- Achieved the single cell capture and increased the rate to 35% at 1/100th the upfront cost using 3D printing techniques.

ACTIVITIES

Teaching Assistant, Whiting School of Engineering, Johns Hopkins University

Aug. 2023 - Present

- Haptic Interface Design for Human-Robot Interaction (EN 530.491/691).
- Intro to Augmented Reality (EN 601.454/654).

Team Leader in Microfluidics, BioInnovation Group at University of California, Davis

Sept. 2021 - Jun. 2022

HONORS & AWARDS

- Best Project Poster Award May 2023
In the *Computer Integrated Surgery II* course at Johns Hopkins University
- Best Project Award Dec. 2022
In *Haptic Interface Design for Human-Robot Interaction* course at Johns Hopkins University
- Excellence in Manufacturing Award Jun. 2022
Senior Design Award at the University of California, Davis
- Dean's Honor Lists Oct. 2021
GPA attained by the upper 16% at the College of Engineering, University of California, Davis

SELECTED COURSES

Computer Science	Augmented Reality, Computer Integrated Surgery I&II, Deep Learning, Computer Vision, Data Structure, Algorithms for Sensor Based Robotics
Electrical Engineering	Biomedical Signal and Control, Circuits System, Microcontroller
Math	Linear Algebra, Differential Equations, Vector Analysis, Statistics, Calculus
Mechanical Engineering	Haptic Interface Design, Manufacturing Processes, Robot Device Kinematics Dynamics and Control, Medical Robotics System Design Statics, Dynamics, Thermodynamics, Mechanics of Materials
Biomedical Engineering	Clinical Application of Biomedical Device Design, Biomaterials, Biotransport Phenomena, Neuroengineering, Biomedical Imaging System

TECHNICAL SKILLS & INTERESTS

- **Programming Languages:** Python, MATLAB, C#, C++
- **Tools:** Unity, ROS, Arduino IDE, 3D Slicer, LaTeX, PyTorch, Git, Simulink
- **CAD Software:** Blender, Solidworks, 3DS Max
- **Manufacturing:** 3D Printing, CNC, Laser Cutting, Drilling, Welding
- **Language:** English (proficient), Chinese (native)
- **Wet Lab:** Cell Culture, 3D Bioprinting, Microscopy
- **Interests:** Badminton, Golf, Traveling