Jin Wu

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EDUCATION

Laboratory for Computational Sensing & Robotics, Johns Hopkins University Aug 2023 - Present

M.S. in Robotics, Overall GPA: 3.81/4.0

Courses: Algorithms for Sensor-Based Robotics, Computer Integrated Surgery I&II, Learning-Based Control for Robotics, Computer Vision, Haptic Interface Design for Human-Robot Interaction,

UM-SJTU Joint Institute, Shanghai Jiao Tong University Aug 2019 - Aug 2023

B.S. in Mechanical Engineering, Overall GPA: 3.72/4.0, **ranked 2/28**

Core Coursework (GPA: 3.95)**:** Intro to Solid Mechanics, Intro to Circuits, Intro to Dynamics and Vibrations, Design and Manufacturing I&II, Linear Algebra, Fluid Mechanics, Intro to Data-driven Engineering Design, Electromagnetics, Modeling Analysis and Control of Dynamic Systems.

University of Wisconsin, Madison Jan 2022 - May 2022

Exchange Program, GPA: 3.70/4.0

Courses: Practicum in Finite Element, Elementary Heat Transfer, Computer Control of Machines and Processes.

CONFERENCE PUBLICATION

Jin Wu, Haoying Zhou, Peter Kazanzides, Adnan Munawar, Anqi Liu, "SurgicAI: A Fine-grained Platform for Data Collection and Benchmarking in Surgical Policy Learning," Accepted to the 2024 Conference on Neural Information Processing Systems (**NeurIPS 2024**).

Qi Zhou, Sikai Li, Jingbo Qu, **Jin Wu**, Haomiao Xu, Youyi Bi, "An Adaptive Path Planning Approach for Digital Twin-Enabled Robot Arm Based on Inverse Kinematics and Deep Reinforcement Learning," Accepted in the ASME 2023 International Mechanical Engineering Congress and Exposition (**IMECE 2023**).

JOURNAL PUBLICATION

Qi Zhou, **Jin Wu**, Boyan Li, Sikai Li, Bohan Feng, Jiangshan Liu, "Adaptive Robot Motion Planning for Smart Manufacturing Based on Digital Twin and Bayesian Optimization-Enhanced Reinforcement Learning," Submitted to **Computers in Industry**.

RESEARCH EXPERIENCES

Hierarchical Language-instructed Policy in Medical Robotics Task Autonomy

Advisor: Prof. Alan Yuille, Johns Hopkins University Jul 2024 - Present

- Developed a scripted control policy for complete multi-wound suturing that includes autonomous correction mechanisms in response to disturbances. Established a comprehensive demonstration dataset containing raw image data from a global endoscope and two wrist cameras, along with proprioceptive data based on both joint and end-effector space.
- Implemented synchronized ROS topics collection for multi-modal data, ensuring precise alignment of data from multiple sources and preprocessing it into observation-action pairs.
- Deployed **Action Chunking Transformer** (ACT) and **Diffusion Policy** to train the low-level policy, leveraging pre-trained **CLIP** ViT encoder as the high-level policy, enabling advanced decision-making and control in long-horizon surgical tasks.

Ratbot: A Surgical Robotic Solution to Enable Brain-wide Recording in Rodents

Advisor: Prof. Tim Harris & Prof. Peter Kazanzides, Johns Hopkins University Jun 2024 - Present

- Developed a **Unity3D** simulation platform to replicate rodent cranial surgery, incorporating high-fidelity CAD models for precise intracranial and extracranial collision detection, alongside the implementation of advanced probe kinematic control.
- Engineered an autonomous multi-probe insertion system utilizing sophisticated trajectory planning techniques, including sampling-based motion planning and artificial potential field methods, to ensure collision-free insertion into the brain.
- Designed an intuitive user interface for probe planning, facilitating real-time mesh visualization, seamless mode transitions, dynamic camera adjustments, and preoperative craniotomy simulations.

SurgicAI: A Fine-grained Platform for Data Collection and Benchmarking in Surgical Policy Learning

Advisor: Prof. Anqi Liu & Prof. Peter Kazanzides, Johns Hopkins University Nov 2023 - Aug 2024

- Built an integrated simulation environment that combines the Gymnasium API with a surgical suturing simulator, provide compatibility with open-source RL library like Stable Baselines3 and d3rlpy.
- Developed a hierarchical learning framework that utilizes one-hot encoded high-level policies for task allocation and modular low-level policies for subtask execution, achieving a **52%** success rate in long-horizon suturing tasks.

- Benchmarked the performance of various online RL algorithms (TD3+HER+BC, DDPG+HER, SAC, PPO, etc.) and offline RL algorithms (CalQL, IQL, BCQ, etc.) for state-based low-level policy learning, achieving over a **90%** success rate with SOTA methods such as TD3+HER+BC.
- Assessed the effectiveness of multiple visual encoders (R3M, CLIP, Pretrained ResNet) in image-based end2end imitation learning, with success rates ranging from **20%** to **80%**, depending on the subtask and camera perspectives.
- Designed and executed a robust pipeline for the collection and processing of human demonstration data, optimizing the system for effective data collection.

Adaptive Motion Planning for Robotic Arm Based on Digital Twin and Reinforcement Learning

Advisor: Prof. Youyi Bi, Shanghai Jiao Tong University Mar 2022 - Aug 2023

- Engineered a comprehensive control system and digital twin simulation for a JAKA robotic arm within the **Unity3D** environment, enhancing real-time interaction and visualization capabilities.
- Applied the Proximal Policy Optimization (PPO) algorithm and inverse kinematics to significantly improve the efficiency of pick-and-place tasks and ensure robust collision avoidance in dynamic environments with obstacles.
- Developed a sophisticated digital twin framework in Unity3D, incorporating the OVE6D pose estimation algorithm through TCP communication to achieve seamless real-time robotic positioning and motion planning.

SELECTED PROJECT

Autonomous electric vehicle with transformable wheels

Advisor: Prof. Jaehyung Ju, Shanghai Jiao Tong University May 2022 - Aug 2022

- Designed a transformable wheel structure using a four-bar rocker-slider linkage in SolidWorks, ensuring compatibility with the selected motor.
- Conducted position and force analysis in MATLAB to simulate stair-climbing processes, calculating safety factors and motor torque requirements.
- Developed an animation to simulate the stair-climbing and tunnel-crossing processes using various wheel configurations.

Automatic clothes folding machine

Advisor: Prof. Youyi Bi, Shanghai Jiao Tong University May 2021 - Aug 2021

- Designed a four-bar linkage system in Solidworks and scripted Arduino program to replicate human-like folding motions.
- Performed motion and torque analysis using MATLAB and FEA to determine the optimal length of each linkage and select the appropriate servo motor.
- Fabricated the machine through laser cutting and 3D printing techniques.

LEADERSHIP AND ACTIVITIES

Department of Computer Science | JHU | *Course Assistant* Feb 2024 - May 2024

- CA of Algorithms for Sensor-Based Robotics (2024 SP), Computer Integrated Surgery I (2024 FA).
- Held weekly office hour and was responsible for homework grading.

Joint Institute Center for Learning and Teaching | UM-SJTU | *Teaching Assistant* Mar 2021 - Aug 2022

- TA of *Solid Mechanics* (2021SP), *Thermodynamics* (2021SU), *Physics II* (2021FA), *Dynamics and Vibrations* (2022SU), *Honor Physics I* (2023SU).
- Conducted weekly recitation classes and office hours in English, and provided support to instructors with coursework.

JI Badminton Club | UM-SJTU **|** *President* Jul 2021 - Jul 2022

- Managed and planned the schedule for badminton games and booked the court weekly.
- Arranged the institutional badminton competitions with University Sport Club.

SELECTED AWARDS

China International Aircraft Design Challenge (CADC): Runner-up in *Vertical Take-off and Landing* Feb 2021 - Nov 2021

- Worked with 5 students and placed **2nd** of **340 teams**, organized by Aero Sports Federation of China.

The University Physics Competition: Silver Medal Nov 2020

- Worked with 2 students and achieved Silver Medal (**Top 1.7% ~ Top 15%**) out of 346 teams.

National Undergraduate Engineering Training Integration Ability Competition: First Prize in *Intelligent logistics UAV, Shanghai area.* Dec 2020 - Mar 2021

SKILLS

Programming Languages: Python, MATLAB, C/C++, C#, R, Latex.

Software: ROS, SolidWorks, Arduino, Unity3D, 3D Slicer, Adobe Premiere Pro, Autodesk Fusion 360, Microsoft Office.

Hardware: 3D printing, laser cutting, mold fabrication, and casting.

Familiar Robot Types: UR5, da Vinci Surgical Robot, JAKA Robotic Arm, Quadcopter Drones.