Chang Chang

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Education

Johns Hopkins University, May 2025 — M.S. in Mechanical Engineering | **GPA 3.83/4.0**

Huazhong University of Science and Technology, June 2023 — B.Eng., in in Mechanical Engineering | **GPA 3.79/4.0**

Skills

- **Robot Planning & Autonomy**: Motion planning (RRT* with obstacles/Combinatorial Motion Planning/A*/Dijkstra/Non-holonomic planning/Cross-entropy Methods…), MoveIt 2, Navigation 2, Reinforcement learning (Dynamic Programming/Q-Learning/…), SLAM/mapping
- **System & Integration**: ROS 2(nodes, actions, services, ros2_control, launch/params, FastDDS, CycloneDDS), Rviz2, Gazebo(Ignition)+ros_ign_bridge, Orocos, system bring-up
- **Embedded System & Real-Time Control**: FreeRTOS, STM32/Teensy/Arduino (C/C++), common communication protocols: (UART/USART, I2C, SPI, CAN, USB/Ethernet), sensor fusion (KF/EKF)
- **Programming & GUI & Modeling:** Python/C++/C, MATLAB/Simulink/Appdesigner, PyQt, Git
- **Fast prototyping: ME:** Mechanical Design → fabrication (SolidWorks / NX / Inventor / AutoCAD; 3D printing, machining, laser cutting) → Assembly; **EE:** PCB (schematic+layout) & wiring; bring-up, debugging and testing (Oscilloscope, multimeter, wave generator, Multisim)

Publications

- **Chang, C.**, Mei, J., Wang, Y., Al-Zogbi, L., Leonard., S., Iordachita., I. Flexible Needle Manipulation and Obstacle Avoidance System for Image-Guided Spinal Interventions, *ISMR2025*, *doi: 10.1109/ISMR67322.2025.11025983*
- Wang, Y., **Chang, C.**, Mei, J., Leonard, S., Taylor, R., Iordachita, I. High-Precision Autonomous Control of Flexible Needles via Real-Time Finite Element Simulation and Cross-Entropy Optimization, *IEEE Robotics and Automation Letters,* 2025, *doi: 10.1109/LRA.2025.3604744*
- Hu, B., Ge, J., **Chang, C.,** Lin, X., Krieger, A., and Mohsenin, T. ASVO: Autonomous Sensor View Optimization for Robotic Casualty Assessment, *ISMR2026, Under review*
- Mei, J., **Chang, C.**, Wang, Y., Al-Zogbi, L., Leonard, S., Iordachita, I. Flexible Needle Manipulation with Realtime Electromagnetic Feedback: Simulation Studies, *ISMR2025, doi: 10.1109/ISMR67322.2025.11025973*
- Wang, Y., **Chang, C.**, Mei, J., Leonard, S., Iordachita, I. Minimally Invasive Flexible Needle Manipulation Based on Finite Element Simulation and Cross Entropy Method, *https://arxiv.org/abs/2411.07890*
- Xie, Y., Jiang, Q., **Chang, C.**, Zhao, X., Yong, H., Ke, X., Wu, Z. A Thermal Cycler Based on Magnetic Induction Heating and Anti-Freezing Water Cooling for Rapid PCR. *Micromachines* **2024**, *15*, 1462. *https://doi.org/10.3390/mi15121462*
- A PCR temperature control system and PCR device, 2024.07. *China Patent*, CN 118389270 A
- A rapid temperature control method and system, 2024.06. *China Patent*, CN 118170188 A
- A rapid temperature control method and system, 2023.12. *China Patent*, CN 117234261 A

Research Experience

Autonomous Navigation and Manipulation on Legged Robots for Quick Disaster response

Baltimore, United States — PI: Dr. Tinoosh Mohsenin — 08/2025-Now

- Developed a **full-stack manipulation control pipeline on Unitree D1**, including forward/inverse kinematics (KDL-based), trajectory planning, and a custom **ros2_control hardware interface** integrated with MoveIt 2.
- Built a **vision-based 3D grasping system** using YOLO + RealSense depth fusion, enabling autonomous grasping tasks.
- Developed a complete multi-sensor hand–eye calibration pipeline for the RealSense–Go2–D1 system, including a universal mathematical model, automated data-collection scripts, marker-pose extraction tools, and custom AX=XB solvers (Tsai–Lenz, Daniilidis dual-quaternion, RANSAC outlier rejection, and nonlinear refinement); validated with synthetic datasets and reduced mean translation error from **200+ mm to ~6 mm**, enabling high-precision perception-driven manipulation.
- Built a legged navigation system integrating Nav2, lidar/vision fusion, and Go2 locomotion control to support arm manipulation in unstructured environments.

- Designed a **hierarchical image-guided manipulation state machine** using TinyFSM for robust grasp execution, fault detection, and automatic error recovery.
- Demonstrated a full "perception → navigation" autonomy loop, deployed on Unitree Go2 + D1 for rapid-response disaster simulation scenarios.

Flexible Needle Manipulation and Obstacle Avoidance System for Image-Guided Spinal Interventions

Baltimore, United States PI: Dr. Iulian Iordachita 03/2024-06/2025

- Designed and manufactured a 2-DOF needle driver **from scratch to entire robot independently**; integrated with electro-magnetic position tracking system as well as Micromate to realize 6-DOF manipulation; **validated key parts via SolidWorks FEA** and **delivered phantom (Hydrogel and Plastisol) and real tissue experiment**.
- Built a wireless control system with **ROS2 and MATLAB** (cross-entropy trajectory generator + FEM-based tracker + nonholonomic RRT+ GUI), **reached submillimeter precision in real tissue.**
- **Designed a multisensor system and human-in-the-loop workflow** for autonomous image guided needle insertion from pre-operative diagnosis, intra-operative manipulation to post-operative check. Implemented CT image **segmentation and registration** with electro-magnetic position tracking system as well as robot.

A rapid Temperature Control System and PCR Device

Wuhan, China PI: Dr. Zhigang Wu 03/2022 -- 6/2023

- Built convective heat transfer model and induction heating **finite element model** in COMSOL Multiphysics, explored the relationship between the equipment temperature cycle performance and related parameters and optimized them
- Deployed a control system on STM32 and applied it successfully. And modelling with **System Identification** toolbox and tested with **Fuzzy PID, Fuzzy Self-tuning PID**
- Implemented a **cascade PID** and eliminated severe thermal hysteresis, achieving average heating and cooling rates of 14.92 °C/s and 13.39 °C/s **(>100% improving**, commercial PCR device only have ~6°C/s).

National University Student Robotics Competition-ROBOMASTER

Wuhan, China PI: Dr. Yujiang Zeng 09/2019 -- 12/2021

- **Corporate with mechanical/electronics teammates** to deliver features and stabilize robot.
- Developed control system based on **FreeRTOS**, **involving common peripherals** like **USART, CAN, I^2C, DMA**
- Optimized the robot's launching mechanism and control algorithms, **achieving ≤10 cm shot dispersion at 5m**
- **Won the first prize at provincial level and the second prize at national level** respectively

Honors

- Silver Medal of 49th International Exhibition of Inventions Geneva (IEIG) 2024
- Bronze Medal of "Internet+" Innovation and Entrepreneurship Competition (Hubei Province, 07/2022)
- Outstanding Student Leader of HUST (2020-2022)
- Bronze Award of "Internet+" Innovation and Entrepreneurship Competition of HUST (06/2022)
- Second Place of RMUL, RoboMaster University League (National-level, 06/2021)
- First Place of RMUL, RoboMaster University League (Province-level, 04/2021)
- Scholarship of Science and Technology Innovation (2020-2021) of HUST
- Outstanding Student Leader (Province-level 2018)

Working/Internship Experience

Johns Hopkins University **Baltimore, United States**

Teaching Assistant of ***Robot Motion Planning*** *and* ***Electronic & Instrumentations*** 01/2025 -- 05/2025

- Grading homework assignments, Hosting Office Hours for problem solving

NARVAL Robotics/ NARVAL Intelligent Technology (Dongguan) Co., LTD **Shenzhen, China**

Hardware QA Engineer 07/2022 -- 08/2022

- Analyzed & tested the hardware circuit. Did black-box and white-box testing

Assisted in combing the code logic of automatic control instruments, doing related EMC testing, etc.