Kaidi Zhang

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EDUCATION

Xi'an Jiaotong-Liverpool University **Suzhou, China**

B.S. Mechatronics and Robotic Systems | First Class Degree | GPA:3.73/4.0 09/2019 – 06/2023

Relevant Courses: Robotics, Mechatronics, Microprocessor Systems, Digital Electronics, Solids & Structures, Engineering Drawing, Mechanical Engineering Design, Dynamic Systems, Instrumentation & Control System, Machine Learning, Pattern Recognition in Computer Vision, Robotic Systems, Fluid Mechanics & Vector Fields for Engineering

Columbia University **New York, USA**

M.S. in Mechanical Engineering | Robotics and Control | GPA:3.73/4.0 06/2023 – 02/2025

Relevant Courses: Applied Robotics:Algorithms & Software, Evolutionary Computation & Design Automation, Artificial Intelligence, Neural Network & Deep Learning, Robot Learning, Computational Aspects of Robotics, Mathematics in Deep Learning

PUBLICATION

[1] **Kaidi Zhang**, Do-Gon Kim, Eric T. Chang, Hua-Hsuan Liang, Zhanpeng He, Kathryn Lampo, Philippe Wu, Ioannis Kymissis, Matei Ciocarlie. (2025). VibeCheck: Using Active Acoustic Tactile Sensing for Contact-Rich Manipulation. IROS. (Under Review)

[2] Heng Zhou, Zhetao Guo, Ren Yuxiang, Shuhong Liu, Lechen Zhang, **Kaidi Zhang**, MingRui Li. (2024). MoD-SLAM: Monocular Dense Mapping for Unbounded 3D Scene Reconstruction. IEEE Robotics and Automation Letters (RA-L), vol. 10, no. 1, pp. 484-491, doi: 10.1109/LRA.2024.3498777.

[3] Mingrui Li, Heng Zhou, Shuhong Liu, Zibing Zhao, **Kaidi Zhang**, Hongyu Wang. (2024). MI-SLAM: Monocular Radiance Field-Informed 3D Gaussian SLAM with IMU Motion Dynamics. AAAI. (Under Review)

RESEARCH INTERESTS

- My research interests focus on advancing **robot perception** through innovative **tactile sensing** designs, and enhancing **intelligent manipulation** and **human-robot interaction** via tactile and visual feedback integration.

RESEARCH EXPERIENCE

Active Acoustic Tactile Sensing with Piezoelectrics in Robotic Hands **New York, USA**

Research Assistant | ROAM Lab | Supervised by Prof. Matei Ciocarlie | Paper Under Review (IROS) 02/2024 – Present

- Lead a project that explores methods for active acoustic sensing in piezoelectric tactile fingers and the capabilities of this sensing method when implemented in multi-fingered dexterous robot hands.
  - Based on acoustic sensing, embedded two piezoelectric sensors on the tactile fingers and built the hardware, mechatronics of this piezoelectric gripper using Teensy 4.0 micro-controller integrated with an Audio Adaptor Board
  - Used this system to classify objects, estimate grasping position, estimate poses of internal structures, and classify the types of extrinsic contacts an object is making with the environment. Tackled a standard long-horizon manipulation problem: peg insertion
  - Built a simple simulated transition model based on the performance of our sensor to train an imitation learning policy that is robust to imperfect predictions from the classifier
  - Finally demonstrate the policy on a UR5 robot with active acoustic sensing as the only feedback.

Research on Monocular Dense Mapping for Unbounded 3D Scene Reconstruction **New York, USA**

Research Project | Supervised by Prof. Hongyu Wang | Paper Published (RAL) 12/2023 – 05/2024

- Proposed MoD-SLAM, the first monocular NeRF-based dense mapping method that allows 3D reconstruction in real-time in unbounded scenes.
  - Incorporated a monocular depth estimation module and a depth distillation module at the front-end. Reviewed and evaluated the use of depth maps of objects to supervise the 3D scene reconstruction process
  - Introduced a novel reparameterization approach which contracts space in spherical coordinates, thus eliminating the NDC forward-facing scene limitations
  - Adopted Gaussian encoding to sample information by projecting a cone towards the pixel center, and introduced a depth -supervised camera tracking method by adding a robust depth loss term to constrain scales
  - Our experiments on two standard datasets show that MoD-SLAM achieves competitive performance, improving the accuracy of the 3D reconstruction and localization by up to 30% and 15% respectively compared with existing monocular SLAM systems

Research on Monocular Radiance Field-Informed 3D Gaussian SLAM with IMU Motion Dynamics **New York, USA**

Research Project | Supervised by Prof. Hongyu Wang | Paper Under Review (AAAI) 03/2024 – 07/2024

- Proposed MI-SLAM, an IMU-based monocular dense radiance field-informed 3D Gaussian SLAM system, which sets neural radiance field as a supervision signal for optimizing the 3D Gaussian point cloud scene representation.
  - Introduce neural radiance fields to act as a prior signal for the initialization of point-based scene representation
  - Propose an IMU-based depth estimation model which can achieve accurate absolute scale estimation in any scene without pre-training
  - Used a camera-centric extended Kalman filter (EKF) to filter out the inherent noise of IMU using relatively accurate visual predictions, resulting in optimal pose output
  - Extensive experiments on Replica, ScanNet, TUM RGB-D and EuRoC demonstrate that MI-SLAM outperforms all state-of-the-art monocular SLAM systems in mapping accuracy, while also showing excellent capabilities in tracking

Evolving a Soft Robot in terms of Locomotion Pattern and Morphology **New York, USA**
Group Project | Columbia University | Evolutionary Computation and Design Automation 10/2023 – 12/2023

- Designed a soft robot and applied evolutionary computation and genetic algorithm to evolve the locomotion pattern and morphology simultaneously.
  - Created a soft bio-robot with 24 atoms and 108 springs in VPython, created a genetic algorithm program using evolutionary technologies including crossover, mutation and maintaining diversity. etc
  - Evolved locomotion parameters including the elastic coefficients of springs, coefficients of periodic oscillation function and phase values of periodic function
  - Evolved the morphology by finding the optimal positions of robot legs, separated the evolving process for body part and legs part in order to optimize the evolving process
  - The resultant robot has a multi-legged bionic structure, which reaches a moving velocity at 0.173m/s (0.233 robot maximum size/second)

Implementation of Depth Supervised Sparse Neural Radiance Grid **New York, USA**
Group Project | Columbia University | Neural Networks & Deep Learning 10/2023 – 12/2023

- Proposed a Depth Supervised Sparse Neural Radian Grid (D-sNeRG) method according to sNeRG and Depth NeRF.
  - Reviewed the Sparse Neural Radian Grid (sNeRG), which is a 3D configuration neural network based on Neural Radiance Field (NeRF)
  - Reviewed and evaluated the use of depth maps of objects to supervise the 3D scene reconstruction process
  - Proposed a Depth Supervised Sparse Neural Radian Grid (D-sNeRG) method to improve the problem of inaccurate scene reconstruction caused by the missing depth map in the original sNeRG rendering process
  - Our final resultant scene has a large improvement in scene rendering accuracy while being able to maintain about the same rendering speed as sNeRG

Design and Implementation of a Self-Balancing Robot based on Inertia Wheel Pendulum Theory **Suzhou, China**
Final Year Project | Xi 'an Jiaotong-Liverpool University | Supervised by Prof. Yuqing Chen 10/2022 – 06/2023

- Designed a two-wheeled self-balancing robot based on inertia wheel pendulum theory. Simulated and built a robot from draft to an object.
  - Reviewed and derived the equations of Inertia Wheel Pendulum theory, inertia and torque analysis, dynamic model, and designed a two-wheeled robot with an inertia wheel in Solidworks
  - Assembled the robot using carbon fiber and 3D-printing technology, simulated the robot system and balancing motion in MATLAB Simulink, optimized and verified the feasibility of the designed model
  - Designed the control system using STM32F103C8T6 microcontroller with an IMU unit, MPU6050, used PWM and PID controller to control two brushless DC motors and one steering gear
  - Debugged the control system and succeeded in controlling robot motion, including going forward or backward and turning directions, and theoretically achieved the balancing motion in the simulation

Fabrication and Optimization of a Soft Phototactic Robot **Suzhou, China**
Research Assistant | Xi 'an Jiaotong-Liverpool University | Supervised by Prof. Pengfei Song 03/2022 – 07/2022

- Researched the principle and innovation of microfluidics devices. Assist the research group to evaluate and optimize a soft phototactic robot.
  - Investigated the theory and method of a soft phototactic robot based on a self-sustained hydrogel oscillator, which achieved hydrogel oscillation under ambient, diffusive light using broadband white light as input and polyaniline (PANi) as absorber
  - Investigated the oscillatory behavior by establishing a built-in negative feedback loop through self-shadowing and efficient diffusion/mass transfer
  - Evaluated a fast-response bioinspired near-infrared light-driven soft robot based on a two-stage deformation, which can generate recoverable, dramatic, and sensitive deformation to execute various tasks
  - Applied strain-induced origami of nanomembranes to bring in the powerful fabrication method with exceptional versatility and applications of 3D cylinder microstructures fabricated from rolling origami

PROFESSIONAL EXPERIENCE

Kunming Shipbuilding Equipment Corporation **Kunming, China**
Robotics Engineering Intern 06/2021 – 07/2021

- Participated in the development of a service robot project, and launched the project to adapt to the company's service.
  - Collaborated with colleagues to make pre-investigation about the service robot, and learned technical quantities, such as SDK (software development kit) and API (application programming interface)
  - Researched the leading technologies implemented on recent service robots, like SLAM and RFID (radio frequency identification), and summarized the basic theories, features and benefits of these technologies
  - Collaborated with OEM and ODM, gaining hands-on experience in technical parameters and hardware functions, and validated optimal results aligned with company objectives

SKILLS

Coding Language: Python | C | MATLAB | ROS

Software: MATLAB | M.S. Office | VisualStudio2013 | Quincy | 20-sim | VisUAL | Dr.Frame2D | PyCharm | AutoCAD | Altera Quartus II | Arduino | LTspice XVII | ANSYS Workbench 2021 | Automation Studio V | Solidworks | Creo | Keil

Languages: Mandarin (Native), English (Fluent | IELTS: 7.5 | GRE: 328)