

LEI ZHOU

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EDUCATION

National University of Singapore

Jan 2021 - Present

Ph.D. in Mechanical Engineering (Advisor: Prof. Marcelo H. Ang Jr.)

- GPA: 4.33/5.00
- Relevant Coursework: Machine Vision; Deep Learning for Robotics; Digital Human

Huazhong University of Science and Technology

Sep 2014 - Jun 2018

B.E. in Mechanical Design, Manufacturing and Automation

- GPA: 86.30/100.00

RESEARCH INTERESTS

My research interests lie at intersection of Computer Vision and Robotic Manipulation. Currently, my research focuses on Embodied AI related topics, including hand mesh reconstruction, reinforcement learning, imitation learning, and visual affordance detection.

PUBLICATIONS

- **Lei Zhou**, Haozhe Wang, Zhengshen Zhang, Zhiyang Liu, Francis EH Tay, and Marcelo H. Ang Jr., “You Only Scan Once: A Dynamic Scene Reconstruction Pipeline for 6-DoF Robotic Grasping of Novel Objects”, ICRA 2024
- Zhengning Zhou, **Lei Zhou**, Shengxin Sun, and Marcelo H. Ang Jr., “A Robust and Efficient Robotic Packing Pipeline with Dissipativity-Based Adaptive Impedance-Force Control”, IROS 2024
- Zhiyang Liu, Ruiteng Zhao, **Lei Zhou**, Chengran Yuan, Yuwei Wu, Sheng Guo, Zhengshen Zhang, and Marcelo H. Ang Jr., “3D Affordance Keypoint Detection for Robotic Manipulation”, IROS 2024
- Zhengshen Zhang, **Lei Zhou**, Chencheng Liu, Chengran Yuan, Sheng Guo, Ruiteng Zhao, Marcelo H. Ang Jr. and Francis EH Tay, “DexGrasp-Diffusion: Diffusion-Based Unified Functional Grasp Synthesis Method for Multi-Dexterous Robotic Hands”, ISRR 2024
- **Lei Zhou**, Zhiyang Liu, Runze Gan, Haozhe Wang, and Marcelo H. Ang Jr., “DR-Pose: A Two-stage Deformation-and-Registration Pipeline for Category-level 6D Object Pose Estimation”, IROS 2023

RESEARCH EXPERIENCE

Reinforcement Learning for Dexterous Robotic Grasping

Aug 2024 – Nov 2024

- Developed a reinforcement learning training pipeline in Isaac-Sim for dexterous robotic hand manipulation.
- Constructed a real-sim-real pipeline, starting with reconstructing everyday objects using NeRF, integrating the reconstructed meshes into RL environments for policy training, and ultimately deploying the trained RL policy in real-world experiments.

Robust Multiview Hand Mesh Reconstruction

May 2024 – Aug 2024

- Developed an optimization-driven multiview hand mesh reconstruction pipeline for the EgoExo4D dataset.
- Designed and implemented a triangulation-based multiview consistency check to filter out outliers in each view's predictions, ensuring robust single-frame hand mesh reconstruction.
- Applied smoothing techniques to the reconstructed hand trajectories across video frames for improved temporal coherence.
- Achieved high precision in 3D keypoint annotation and temporal consistency, with over 70% of frames (10 M) across the video sequence validated for use in 4D hand pose estimation and Vision-Language-Action (VLA) pretraining.

Diffusion-based Multi-Hands Robotic Grasp Generation

Nov 2023 - Mar 2024

- Designed a unified diffusion network generating grasp pose for multiple robotic dexterous hands, achieving 44.73% overall success rate on MultiDex Dataset.
- Introduced several conditions to improve generalizability of diffusion network spanning five dexterous hands.

- Built a discriminator to filter functional grasps via open-vocabulary visual affordance detection and object-gripper contact analysis.

Dynamic Scene Reconstruction for Robotic Grasping

Jun 2023 - Sep 2023

- Leveraged SDF-based methods to reconstruct meshes for novel objects from multi-view images in workspace.
- Proposed a dynamic scene reconstruction pipeline that completes object partial point clouds by transforming reconstructed object meshes back into workspace with tracked object poses at speed of 9.2 FPS.
- Achieved state-of-the-art performance on GraspNet-1Billion benchmark for downstream robotic grasping task.
- First author paper accepted by ICRA 2024.

Learning from Human Hand-Object Interaction

Mar 2023 - Jun 2023

- Analyzed human hand-object interaction and generated contact map based on signed distance field.
- Explored strategies to map human hand pose based on MANO hand model to stable robotic grasp pose for parallel gripper and achieved 87.00% success rate on DexYCB dataset.

Category Level Object Pose Estimation

Jan 2022 - Mar 2023

- Analyzed inherent limitations in shape prior-based category-level object pose estimation methods and proposed a two-stage pipeline to mitigate research gaps in each stage.
- Proposed a shape-completion based category-level CAD model reconstruction network and achieved state-of-the-art reconstruction accuracy among shape prior-based methods.
- First author paper accepted by IROS 2023.

WORK EXPERIENCE

Intern

May 2024 – Present

Microsoft Research Asia – Beijing (Supervisor: Jiaolong Yang)

- Contributed to Embodied AI research, focusing on data scaling techniques for Vision-Language-Action (VLA) training and offline policy distillation.
- Developed a robust multiview hand mesh reconstruction pipeline to regenerate ground truth annotations for the EgoExo4D dataset, addressing the challenges posed by noisy and incomplete 3D annotations in the original release, which were unsuitable for VLA training.
- Designed and implemented a real-sim-real pipeline for reinforcement learning (RL) training, enabling the deployment of RL policies for dexterous robotic hands in real-world experiments.

Research Assistant

Jan 2021 – May 2024

Advanced Robotics Centre, National University of Singapore

- Participated in the Human-Robot Collaborative Artificial Intelligence (Collab AI) project, an AME Programmatic Programme led by IHPC in collaboration with I2R, ARTC, NUS, NTU, and SUTD.
- Implemented Instant-NGP algorithm to reconstruct workspace and tray in vertical farming scenario, providing point cloud for subsequent detection and localization algorithms in harvesting.
- Developed and deployed high-level robot control action library on real robots (Franka Emika and Kinova Movo).
- Created a synthetic object pose estimation dataset for gearbox parts using NDDS pipeline in UE4 Engine and trained an instance-level object pose estimation algorithm for gearbox assembly task.
- Developed and deployed robotic grasp generation and visual affordance detection algorithms on real robots for table clearing task.
- Mentored Master's students and junior Ph.D. students.

SKILLS

- Technical: Python, PyTorch, ROS.
- Language: Mandarin (native), English (fluent).