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: 3.80/4.00
- Honors: Outstanding Graduate

RESEARCH INTERESTS

My research interests lie at intersection of Computer Vision and Computer Graphics. Currently, my research focuses on intelligent content creation, including human/robot interaction, video generation and 3D content generation.

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.
- **Lei Zhou**, Zhiyang Liu, Runze Gan, Haozhe Wang, and Marcelo H. Ang Jr., "DR-Pose: A Two-stage Deformation-an-Registration Pipeline for Category-level 6D Object Pose Estimation", IROS 2023.
- Zhengshen Zhang, **Lei Zhou**, Chenchen Liu, Zhiyang Liu, Chengran Yuan, Sheng Guo, Ruiteng Zhao, Marcelo H. Ang. Jr., and Francis EH Tay, "DexGrasp-Diffusion: Diffusion-based Unified Functional Grasp Synthesis Pipeline for Multi-Dexterous Robotic Hands", submitted to IROS 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", submitted to 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", submitted to IROS 2024.
- Zhiyang Liu, Rui Zheng, **Lei Zhou**, and Marcelo H. Ang Jr., "Efficient Initialization and Fine-Tuning for Quantized Mobile Vision Language Models", submitted to ECCV 2024.

RESEARCH EXPERIENCE

Diffusion-based Transparent Object Depth Estimation **Feb 2024 - Present**

- Developing a diffusion network conditioned on RGB and raw depth images to iteratively estimate depth values of transparent object region.
- Implementing transfer learning by incorporating a pretrained condition feature encoder with denoising model for efficient training.
- Evaluating network performance spanning various diffusion network designs and achieved near SOTA result.

Diffusion-based Multi-Hands Robotic Grasp Generation **Nov 2023 - Feb 2024**

- Designed a unified diffusion network generating grasp pose for multiple robotic dexterous hands, achieving 44.73% overall success rate.
- 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 NeRF-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

Research Assistant **Jan 2021 - Present**

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).