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Liu Yang

Summary

Experienced R&D in 3D vision, currently working at MedTech to develop 3D perception & reconstruction algorithms for surgical robots. Holds a PhD from Purdue University in 3D perceptions for robotics. Hands-on experience with various projects in 3D detection, segmentation, and reconstruction, using both cameras and LiDAR. Seeking opportunities in ML computer vision engineers.

Education

Purdue University, PhD **2018 - 2023**

Civil Engineering

- Area of focus: 3D Onsite Perception & 3D Reconstruction for Construction Robots.
- Dissertation: "*Redefining 3D Visual Perceptions for Constructions Robots: Learning from Dynamic Features and Semantic Composition*".

University of Michigan – Ann Arbor, MS **2016 - 2018**

Civil Engineering

- Area of focus: Smart cities, Autonomous and Connected Vehicles.

Tianjin University, BS **2012 - 2016**

Civil Engineering

Technical Skills

- **Programming & Frameworks:** Python, C++, PyTorch, OpenCV
- **Deep Learning:** CNNs, Transformers, NeRF, 3D Gaussian Splatting, GAN
- **3D Vision:** 3D Detection & Segmentation, Depth Estimation, 3D Reconstruction, SfM
- **Sensors**: Cameras, LiDAR Point Clouds, Camera & LiDAR fusion

CVPR Challenge Award

1st Place in *Computer Vision for Built Environment – 3D Segmentation Challenge* **June 2021**

- Led a team of two to achieve *first place* among all competing teams globally, with a *90% mIoU* score.
- Generated *large-scale synthetic 3D point clouds datasets* to augment unlabeled raw point clouds.
- Developed a *sim2real GAN method* to mitigate the domain gap between real and synthetic data.

Work Experience

Research & Development Engineer **2023 – Present**

AIScope Inc.

- **Key Skill Sets: 3D Reconstruction, Stereo Depth, Transformer, NeRF**
  - Developed *a preprocessing pipeline* for low-quality inputs, leading to *25% model improvement.*
  - Applied *Transformer with sparse attention* for depth estimation, within *5mm error* in anatomy.
  - Rearchitected *NeRF by adding semantic and depth priors* for generating simulated datasets.
  - Exploring *3D generative models* including Zero123, DreamFusion, etc.

Projects Experience

Graduate Research Assistant **2018 - 2023**

Purdue University

Project 1: 3D Perception & Reconstruction for Construction Robots | *Publications [1 & 2]*

- **Key Skill Sets: Camera-based 3D Detection, 2D Lifting, SLAM, Camera & LiDAR Fusion**
  - Implemented 3D object detection by *lifting 2D detection from YOLOv3 to 3D space.*
  - Reconstructed *dense 3D scene representation using NeRF-SLAM*, with real-time performance.
  - Explored *early-stage fusion of 2D camera and 3D LiDAR* data for performance improvement.

Project 2: Reconstruct 3D Bridge Assets from Large-Scale Point Clouds | *Publication [4]*

- **Key Skill Sets: 3D Segmentation, PointPillars, PointTransformer, Simulated Data**
  - Generated 3D synthetic data by *simulating LiDAR scans in Blender* to augment real data.
  - Implemented both *point pointwise (PointTransformer) and voxelwise (PointPillars)* segmentation.
  - Improved semantic segmentation with geometric partition, *leading to 4.5% mIoU increase.*

Project 3: Vision-based 2D Worker Tracking and Trajectory Prediction | *Publications [5-7]*

- **Key Skill Sets: Multi-Object Tracking, Head Pose Estimation, Multi-Task Learning**
  - Tracked bboxes of multiple workers in images using *DeepSORT with YOLOv3*.
  - Applied *multi-task learning using YOLOv3* for head pose estimation and visual attention.
  - Applied *LSTM to predict seq2seq worker trajectory* based on human visual attention cues.

Selected Publications

1. **Liu Yang** and Hubo Cai, Unsupervised Video Object Segmentation for Enhanced SLAM-based Localization in Dynamic Construction Environments, *Automation in Construction,* 158 (2024), 105235.
2. **Liu Yang** and Hubo Cai, Enhanced Visual SLAM for Construction Robots by Efficient Integration of Dynamic Object Segmentation and Scene Semantics, *Advanced Engineering Informatics*, 59 (2024): 102313.
3. **Liu Yang** and Hubo Cai, Cost-Efficient Image Semantic Segmentation for Indoor Scene Understanding Using Weakly Supervised Learning and BIM, *Journal of Computing in Civil Engineering,* 37 (2023).
4. **Liu Yang,** Yi-Chun Lin, Ayman Habib, and Hubo Cai, From Scans to Parametric BIM: An Enhanced Framework Using Synthetic Data Augmentation and Parametric Modeling for Highway Bridges, *Journal of Computing in Civil Engineering*, 38(3), p.04024008.
5. Jiannan Cai, **Liu Yang,** Yuxi Zhang, Shuai Li, and Hubo Cai, Multi-task learning method for detecting the visual focus of attention of construction workers, *Journal of Construction Engineering and Management,* 147, (7), 04021063, 2021.
6. Jiannan Cai, **Liu Yang**, Yuxi Zhang, and Hubo Cai, Estimating the visual attention of construction workers from head pose using convolutional neural network-based multi-task learning, in *Construction Research Congress 2020*, American Society of Civil Engineers Reston, VA, 2020, pp.116–124.
7. Jiannan Cai, Yuxi Zhang, **Liu Yang,** Hubo Cai, and Shuai Li, A context-augmented deep learning approach for worker trajectory prediction on unstructured and dynamic construction sites, *Advanced Engineering Informatics,* 46, 101173, 2020.