Weize Li

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Education

Beijing University of Civil Engineering and Architecture *Beijing, China*

B.Eng in Mechatronic Engineering (National First-class Discipline Program) *Sept 2018 - July 2022*
- **[Top1%]** Outstanding Undergraduate Thesis Award, Beijing Education Commission, 2022.
- **[Silver Award]** Beijing Challenge Cup: Entrepreneurial Plan Competition (AI System-Track), 2022.
- Thesis Title: Investigating Anomaly Detection in Power System Data through Deep Learning.

Research Interest

My **long-term research goal** is to build agents that can effectively understand 3D worlds based on vision and be able to combine visual concepts and external knowledge for interpretable reasoning. Further, being able to apply the learned knowledge from reconstruction to generation and editing the digital world, towards the ultimate goal from understanding to changing the world.

Computer Vision 3D scene understanding with multi-modal; Visual-grounded reasoning; Anomaly Detection.
Computer Graphics Scene representations (NeRFs, 3DGS); 3D scene/object reconstruction, generation and editing.
Robotics Robot manipulation; Interpretable planning with LLMs.

Research Experience

Institute for AI Industry Research (AIR), Tsinghua University *Beijing, China*

Research Intern @ **DISCOVER Lab** | Advisor: **Prof. Hao Zhao** *May 2022 - Present*
- **Topic:** 3D Scene Understanding and Editing; Visual Reasoning for Embodied AI; Anomaly Detection.
- Maintaining the curated list of papers for Neural Fields Editing approach on Github: *awesome-nerf-editing*.

Institute of Automation, Chinese Academy of Sciences *Beijing, China*

Visiting Student @ **IIS Research Center** | Advisor: **Dr. Chengfei Zhu** and **Prof. Shuxiao Li** *Feb 2022 - Aug 2022*
- **Topic:** Industry Anomaly Detection; Cross-domain few-shot Learning; Model Deployment.

Beijing University of Civil Engineering and Architecture *Beijing, China*

Research Assistant @ **Urban Power Grid Research Group** | Advisor: **Prof. Miao Yu** *Sept 2020 - Dec 2021*
- **Topic:** Power System Data Analysis; Time-series Anomaly detection.

Publications

(* denotes equal contribution; † denotes corresponding author.)

CONFERENCE PROCEEDINGS

TOD3Cap: Towards 3D Dense Captioning in Outdoor Scenes
Bu Jin, Yupeng Zheng, Pengfei Li, **Weize Li**, Yuhang Zheng, al. Xiaoxiao Long, Yilun Chen, Hao Zhao
ECCV 2024 Under Review, 2024

PAD: A Dataset and Benchmark for Pose-agnostic Anomaly Detection
Weize Li*, Qiang Zhou*, Lihan Jiang, Guoliang Wang, Guyue Zhou, Shanghang Zhang, Hao Zhao
NeurIPS 2023 Datasets and Benchmarks Track (Poster), 2023

JOURNAL ARTICLES

Advances in Radiance Fields: A Survey on 3D Editing
Weize Li*, Tianshu Kuai*, Huan-ang Gao, Trina Tian, Yuhang Zheng, Zheng Yupeng, al. (Author List TBD)
TPAMI Ongoing, 2024

IRFLMDNN: Hybrid Model for PMU Data Anomaly Detection and Re-Filling with IRF and LM Algorithm Optimized DNN
Miao Yu†, Chenyu Yang*, **Weize Li***, Weijie Du, Jinglin Li
Neural Comput. Appl. 2023

PATENTS

Power low frequency oscillation data anomaly monitoring system v1.0[s]
Miao Yu, **Weize Li**, Chenyu Yang, Jinglin Li, Jingxuan Hu, Weijie Du, Shouzhi Zhang
Chinese Computer Software Patent. No.2022SR0277090, 2022

Power low frequency oscillation data acquisition system v1.0[s]
Miao Yu, Chenyu Yang, **Weize Li**, Jinglin Li, Jingxuan Hu, Weijie Du, Shouzhi Zhang
Chinese Computer Software Patent. No.2022SR0281546, 2022

Skills

Programming Python (PyTorch, NumPy, Scikit-learn. etc.), MATLAB, C/C#, HTML/CSS.
Tools Linux, Git, Shell (Bash/Tmux), LaTeX(Overleaf/Markdown), Slurm, Adobe Illustrator.
Language Chinese (Native), English (Proficiency).

Selected Projects

3D Embodied Scene Understanding and Interpretable Reasoning.

AIR-SUN Research Project | Advised by **Prof. Hao Zhao** and **Prof. Yixin Zhu**   *In Progress*

- **Motivation:** Overcoming limitations of current scene understanding models and end-to-end visual reasoning models, enabling embodied agents to learn and apply concepts in the real physical world with both interpretability and generalizable.
- **Challenges:** Handling complex question categories in the SQA3D dataset, accurately parsing questions into executable programs, dealing with complex combinations of concepts in 3D scenes, and determining global spatial relationships in situated embodied QA tasks.
- **Method:** Designing a pipeline for the SQA3D task with a 3D Object-centric Encoder, LLM-based Question Parser, and Neural Program Executor. Utilizing neuro-symbolic methods and combining techniques from CoT, 3D Bongard Problems, and VLMs to address challenges and enhance embodied agents' reasoning and planning abilities.

Sketch-based Graph Optimization for City-Level 3D Scene Generation and Skyline Editing.

AIR-SUN Research Project | Advised by **Prof. Hao Zhao** and Prof. Yuejia Xu   *In Progress*

- **Topics:** Led a research project during the winter research camp at AIR, focusing on city-level 3D editing and generation tasks, transitioning from instance-level to scene-level exploration.
- **Method:** Utilized computational design methods to edit and manipulate the entire city skyline from a high viewpoint, allowing for artistic vision and reshaping of the cityscape. Implemented graph nodes to represent building instances, including footprint, asset information, and height, with added physical constraints to prevent collisions and dictate spacing. Employed hand-drawn skyline shape curves as an optimization objective to reorganize the positions and heights of instances, aligning them with the desired shape. Project submission planned for Siggraph Asia 2024.

3D Vehicle Reconstruction from a single view image in Autonomous Driving Simulator.

AIR-SUN Research Project | Advised by **Prof. Hao Zhao**, **Prof. Yiyi Liao**   *July 2023*

- **Motivation:** Explored and further improved our group's NeRF-based Autonomous Driving Simulator - *MARS*, aiming to provide a more realistic and decoupled simulation of corner cases for autonomous driving.
- **Contribution:** Investigated single-image-to-3D methods like Zero1-to-3 and Make-It-3D to enhance the quality of multi-view car instances in simulation scenes, with a focus on fine-tuning models using the "Car" labeled 3D assets from the Objaverse dataset. However, the results of fine-tuning these large models were not promising, indicating the limitations of this approach.

Dataset and Benchmark for Pose-agnostic Anomaly Detection.

AIR Summer Research | Advised by **Dr. Qiang Zhou**, **Prof. Shanghang Zhang**, **Prof. Hao Zhao**   *May 2023*

- **Motivation:** Existing anomaly detection datasets lack comprehensive visual information from various pose angles, resulting in unrealistic assumptions. Real-world anomalies can arise from different poses, making it necessary to study pose-agnostic anomaly detection. Moreover, the absence of a standardized experimental setup obstructs fair comparisons between methods, emphasizing the need for a consensus on experimental settings in this field.
- **Approach:** We defined the Pose-agnostic Anomaly Detection (PAD) setup and developed a large-scale dataset composed of Lego toy objects. We benchmarked 11 state-of-the-art methods for PAD. Additionally, we proposed the first NeRF-based framework for object anomaly detection.
- **Contribution:** My contributions to this project include dataset design and collection, benchmark establishment, module design, chart creation, writing, and lead the rebuttal process.

McADTR: Multi-class Anomaly Detection Transformer with Heterogeneous Knowledge Distillation.

AIR Summer Research | Advised by **Dr. Qiang Zhou**, **Prof. Hao Zhao**, **Prof. Li Yi**   *Oct 2022*

- **Motivation:** Existing methods need to train models separately for different classes, and a unified framework is needed. Anomaly detection methods based on reconstruction are vulnerable to "identical mapping", i.e., they can recover normal and anomalous samples well enough to make them still indistinguishable.
- **Method:** We follow the typical teacher-student architecture, where fixed pre-trained CNN as teachers provide a priori knowledge of reconstruction capabilities, and well-designed ViT with learnable query as student to train on AD dataset and circumvent 'identical mapping' by utilizing the ability to learn global features at a shallow layer.

Medical Device Product Anomaly Detection Model Deployment.

Visiting Research Project | Advised by **Dr. Chengfei Zhu**, **Prof. Shuxiao Li**   *May 2022*

- **Motivation:** State-of-the-art anomaly detection methods excel within specific datasets, but for real-world Medical Device scenarios, challenges arise due to the lack of negative samples for training and significant domain gaps, hindering the effectiveness of straightforward transfer applications.
- **Contribution:** My contributions to this project include deploying anomaly detection and localization models using OpenCV and C#. Visualize anomaly regions by using heatmap. State-of-the-art methods are reproduced for evaluation on our dataset. Experiment with different finetune parameters to get the best cross-domain few-shot transfer performance.