Rui Qian

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RESEARCH INTERESTS

3D Computer Vision, Robotic Perception, Spatial Intelligence

EDUCATION

Nanyang Technological University, Singapore Aug 2024 – Present
Master of Science in Computer Control and Automation
Thesis: "Application of Large Models for Multiple-View Camera Perception"
Supervisor: Prof. Lihua Xie
GPA: 4.6/5.0

Changzhou University (non 10043), China Oct 2020 – Jun 2024
Bachelor of Science in Electronic Information Engineering
Thesis: "An Urban Traffic Update System Based on Edge-Cloud Collaboration"
Supervisor: Lect. Chengtao Feng
GPA: 4.5/5.0, Ranking: Top 2%

RESEARCH EXPERIENCE

SplatSSC: Decoupled Depth-Guided Gaussian Splatting for Semantic Scene Completion Jan 2025–Aug 2025
Research Project, Nanyang Technological University
Supervisor: Prof. Lihua Xie, Dr. Shenghai Yuan
Technologies: PyTorch, CUDA, **3D Gaussian Splatting**, **Occupancy Networks**

- **Achieved State-of-the-Art Performance:** Developed SplatSSC, a novel framework for monocular 3D Semantic Scene Completion, achieving SOTA results on the Occ-ScanNet benchmark by outperforming prior methods by a significant margin of 6.3% in IoU and 4.1% in mIoU.
- **Innovated Depth-Guided Primitive Initialization:** Addressed the core inefficiency of prior works by designing a depth-guided strategy that uses a bespoke Group-wise Multi-scale Fusion module to generate a sparse and high-quality set of initial Gaussian primitives.
- **Invented a Decoupled Aggregation Method:** Proposed the Decoupled Gaussian Aggregator to handle outlier primitives. By decomposing geometry and semantic predictions, this method effectively eliminates the "floaters" that constrain previous Gaussian-to-voxel splatting methods.
- **Enhanced Computational Efficiency:** Delivered a model that is not only more accurate but also more efficient, reducing inference latency by 9.32% and memory consumption by 9.64% compared to the previous SOTA model.

Multi-task fisheye camera dataset Aug 2024–Nov 2024
Research Project, Nanyang Technological University
Supervisor: Prof. Lihua Xie, Dr. Shenghai Yuan
Technologies: C++, ROS, LiDAR, Radar, **Point Cloud**, **3D Gaussian Splatting**

- **System Development & Calibration**: Developed and calibrated a multi-sensor system integrating fisheye cameras, LiDAR, and mmWave radar for multi-modal data acquisition
- **3D Reconstruction Pipeline:** Engineered a data processing pipeline for the ScanNet++ dataset, implementing multi-view point cloud registration and leveraging 3D Gaussian Splatting (Splatt3r) for high-fidelity scene reconstruction and synthetic data generation.

End-Edge-Cloud Collaborative Urban Road-Condition Update System Oct 2023–Jun 2024
Undergraduate Thesis, Changzhou University
Supervisor: Lect. Chengtao Feng
Technologies: ROS, **SLAM**, **Occupancy Networks**, **Visual Fundation Model**, Cloud Technology

- **System Implementation & Integration:** Designed and implemented a novel Edge-Cloud collaborative system for offline urban road condition updates, integrating a robust positioning module (VIO-GNSS fusion) and a 3D environmental perception module.
- **Perception Model Design & Exploration:** Explored lightweighting techniques for Occupancy Networks (Occ) and designed a novel architecture aimed at deployment on resource-constrained hardware. The proposed design reduces computational load by compressing 3D voxels to a 2D feature space and enhances scene understanding through multi-modal feature fusion.
- **End-to-End Data Pipeline Development:** Developed a complete vehicle-end data pipeline, including a low-cost, automated annotation workflow leveraging visual foundation models (Grounded-SAM, Depth Anything) and a post-processing module that uses clustering algorithms to generate structured data for cloud synchronization and client-side visualization.
- **Edge-Cloud Architecture Design:** Conceptualized a collaborative Edge-Cloud architecture for crowdsourced mapping. This design specifies the edge (vehicle) for autonomous perception and localization and the cloud for aggregating multi-source data to maintain and serve a dynamic, city-scale road condition map for downstream tasks.

INTERNSHIP EXPERIENCE

Object Detection and Anomaly Analysis in Railway Maintenance Scenarios Jul 2023–Aug 2023
Commercial Project, Kingyoung Intelligent Science & Technology Co. Ltd
R&D Manager: Tao Jiang
Technologies: YOLO, OpenCV

- **Data Annotation & Model Optimization:** Led data annotation efforts for custom object recognition datasets and optimized a YOLOv7 model by tuning anchor configurations and training parameters, achieving a 20% increase in model recall.
- **Traditional CV for Defect Detection:** Developed a defect detection system in C++ using the OpenCV library, applying morphological processing and color space analysis to identify foreign objects on product surfaces.

PUBLICATIONS

[1] Rui Qian*, Haozhi Cao*, Tianchen Deng, Shenghai Yuan and Lihua Xie
SplatSSC: Decoupled Depth-Guided Gaussian Splatting for Semantic Scene Completion
arXiv:2508.02261. 2025. **[Under review]**

AWARDS AND HONORS

- **Jiangsu Provincial Excellent Undergraduate Thesis (or Design)** Oct.2024

REFERENCES

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