Renyun Li

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Education

New York University   *Advisor Yao Wang*   **Sep. 2021 – May 2023**
GPA: 3.7   MS in Computer Engineering   Focusing on Image and Video Processing, 3D Vision

Tsinghua University   *Advisor Jianyu Chen*   **May 2021 – Sep. 2021**
Visiting Scholar in IIIS   Focusing on RL, Autonomous Driving, SLAM

Tianjin University   *Advisor Tiegen Liu*   **Sep. 2016 – May 2020**
GPA: 3.4   BS in ECE   Focusing on SLAM, Robotics, Image and Video Processing, Optics

Technical Skills

Languages: Python, C++, CUDA
Field: CV, Image Processing, Optics, SLAM, 3D Point Cloud, ROS, RL, software-hardware co-design
Tools: Linux, PyTorch, Caffe, HPC, GCP, AWS, Apollo, CARLA, Unreal, OpenACC

Research/Working Experience

New York University   **Jan. 2023 – Present**
Full-Time Researcher in Video Lab, advised by Prof. Yao Wang   *June 2023 - Present*

- Derived a unique method to compress 4D video given the prediction of each voxel of the next frame by Huffman coding.

- For 4D video, sampled each frame into 3D point cloud and output the prediction by the aforementioned model.

- By utilizing the prediction of the current frame, searched for related parts in the next frame within the Axis-Aligned Bounding Box and computed the rigid transformation by ICP local matching. Given each voxel prediction, compressed the whole video by Huffman Coding.

New York University   **Jan. 2023 – Present**
Research Assistant in Video Lab, advised by Prof. Yao Wang   *Jan. 2023 - June 2023*

- Generated dataset for **segmenting human body point clouds** from 4D dynamic FAUST video with **3x** samples than **Shapenet**, and **100x** point clouds per sample, generated normal vectors from 3D point cloud by octree.

- Developed a 3D point cloud augmentation algorithm rooted in the Special Euclidean Group in 3 dimensions (SE(3)).

- Created a PointNet-based model with a dynamic kernel and multiple frames as input, which demonstrated exceptional performance with 97% accuracy on human part segmentation and owned the robustness to generalize to unseen subjects and actions with real clothing and hair.

Tsinghua University   **June 2021 – Sep. 2021**
Visiting Scholar in Intelligent Systems and Robotics (ISR) Lab, IIIS, advised by Prof. Jianyu Chen

- Generated a virtual environment based on ROS, Webots Turtlebot3, and Gazebo, and trained a robot car to explore the environment without collision using **RL**, while also reconstructing the map using **Lidar-SLAM**.

- Created an **Autonomous Driving** model consisting of a Deep Imitation Learning trajectory planner and safety tracking controller. Implemented the open and close loop evaluation on **CARLA** in training town and new town, the model's collision achieved 6.5 and 8.2 km/infraction desperately.

NXP Semiconductors   **Jan. 2021 – June 2021**
Software Engineer Intern in Edge Processing team, advised by Mingkai Hu

- Engaged in AIoT, TinyML, Visual-SLAM on Embedded Systems with software-hardware co-design.

- Besides optimizing the extraction and matching algorithm, leveraged the NXP LS1028 development board's memory hierarchy for efficient multicore utilization and minimized memory allocations through parallelization. This allowed for the efficient reconstruction of **3D point clouds** of the environment by a monocular camera and **ROS**.

- Worked with the Edge Processing team on implementing **Azure RTOS** ThreadX and EVK-MIMXRT1170 as an optional component of the MCUXpresso SDK Builder, and implementing **TinyML on Embedded System**.

Projects

Bridging 2D Segmentation to Empower 3D Scene Understanding   **Aug. 2023**
- Rendered 3D objects into 2D images through Pointersect, which would generate different views of the 3D objects. Then segmented the 2D images to generate the predicted label and obtain predicted segmentation masks.
- Propagated the predicted 2D segmentation labels back into the 3D scene by NeRFs. Generate a coarse estimate of semantic labels for 3D scenes based on the propagated labels from the inverse rendering process. This would generate initial 3D labels from 2D predictions and benefit 3D segmentation.

Optimizing Swin-T with Modified Shifted Window Attention   **May. 2022**
- Modified Shifted Window Attention based on **Swin-T**, achieving 95.72% top-1 accuracy on CIFAR100 with 26.7M parameters, which is competitive with **SOTA** (96.01%) and outperforms second-best benchmark (95.1%).
- Improved accuracy of modified Swin-T by 82.2% at top-1 using **Knowledge Distillation** with pre-trained Swin-L.

3D Human Face Reconstruction from RGB image   **Dec. 2021**
- Extracted the landmarks from CACD2000 by face alignment, captured statistical variations in facial shape and texture. Aligned 3DMM to the facial landmarks, and leveraged its shape representation to fit the model to the detected points.
- Mapped information from 3DMM to the aligned 3D face shape, capture the detail variations. Conducted mesh smoothing and refinement to optimize geometry, then rendered through Soft-Rasterizer.
- Took the image and landmark as input pair to ResNet50, with Image, Perception and Regularization loss function.
- Customized 3D Face models for each person and created a playground to enjoy.

Active Multi-Sensory Inspection Robot   **Nov. 2019**
- Constructed an optical fiber sensor system that can detect sound vibration and PM concentration in electromagnetic interference. Implemented it on an inspection robot with the ability to detect suspicious objects and path planning.
- Employed LiDAR-SLAM and ROS, processed 3D point clouds and signals to reconstruct the environment. Then implemented SIFT to track objects and programmed to visualize sensor signals on Raspberry Pi.
- Given the limitation of LiDAR-SLAM for dynamic objects, utilized ORB-SLAM2 and optimized ORBextractor algorithm and deployed YOLOv1 for real-time object detection.
- Published one paper in SPIE, received three national awards, and was granted a patent CN110764500A

Teaching Assistant

- NYU CS-GY 6953 Deep Learning TA, with Prof. Chinmay Hegde, Spring 2023
- NYU Summer K12 STEM Senior Instructor of Introduction to Machine Learning <u>Link</u>, Summer 2022
- Tianjin University Optical Engineering TA, Spring 2020
- Tianjin University Multi-sensor System TA, Fall 2019
- Tianjin University Freshman class mentor, 2017 and 2018

Selected Awards

- Special Prize of China Undergraduate Physics Tournament, North Division (ranking 1/17), 2018
- First Prize of China Undergraduate Physics Tournament (ranking 5/63), 2018   <u>News</u>
- First Prize in Disruptive Innovation and Creation Competition, 2018   <u>Video</u>
- Student Science Award (The youngest candidate out of 10 students in all undergraduate and grad), 2018
- Chinese Undergrad Innovation Seminar (top 1%), 2019   <u>Poster</u>
- Special Prize of Chinese National Undergrad Challenge Cup (top 1%), 2019   <u>Poster</u>
- Outstanding Graduate in Tianjin University (top 5%), 2020
- CN Patent: Multisensory Autonomous Inspection Robot Device and Its Control Method   <u>File</u>
- CN Patent: Neural Network-Based Ultrasound Levitation 3D Manipulation Control Method and System   <u>File</u>
- Flywheel-like diaphragm-based fiber-optic Fabry–Perot frequency tailored acoustic sensor. X Qi, S Wang, J Jiang, K Liu, P Zhang, R Li, T Liu. Journal of Physics D: Applied Physics 53 (41), 415102   <u>Paper</u>
- Miniaturized fiber optic Fabry-Perot pressure measuring system used for marine pressure measurement. X Qi, W Wu, S Wang, J Jiang, W Jia, Y Che, R Li, T Liu. Advanced Sensor Systems and Applications IX 11191, 33-38   <u>Paper</u>