# Simulation Data for Realistic Semantic Segmentation Model (Sim4Real)

Xiang Pan (xp2030), Yuxuan Sun(ys4375)

Cityscape

Capture & label manually

KITTI
(target dataset)

Generated & labeled by simulation?

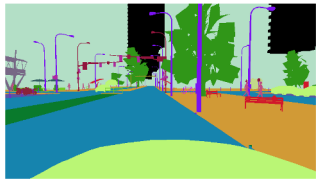
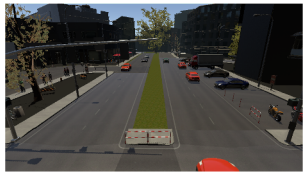
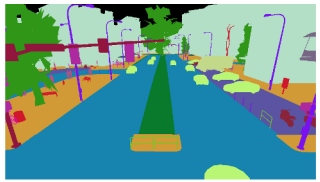
Camera View

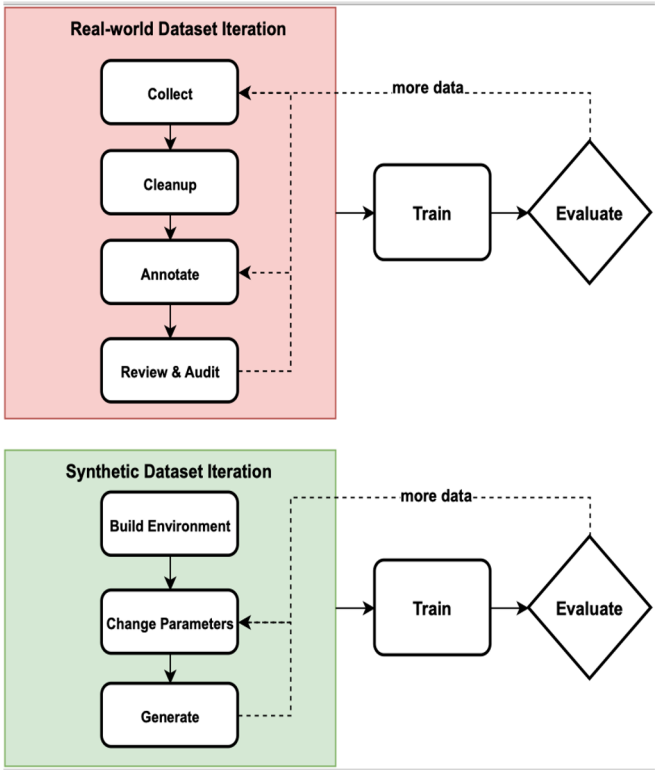
+

Street View





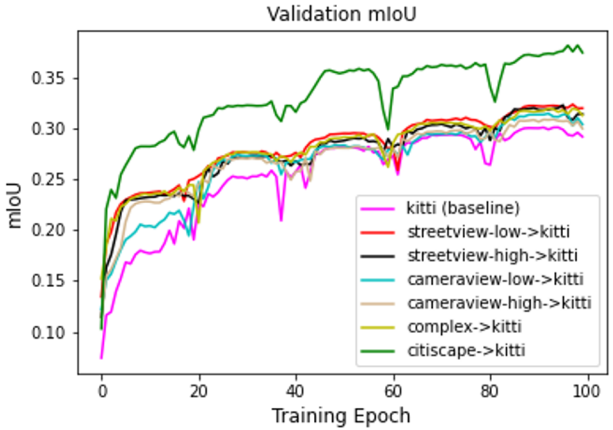



https://github.com/Xiang-Pan/NYU_CV_Project

[1] Steve Borkman, Adam Crespi, etc. Unity Perception: Generate Synthetic Data for Computer Vision, 2021
[2] Geiger, Andreas, Philip Lenz, and Raquel Urtasun. Are we ready for autonomous driving? the kitti vision benchmark suite, 2015.
[3] Marius Cordts, Mohamed Omran, etc. The Cityscapes Dataset for Semantic Urban Scene Understanding, 2016.

| Training Data | Val Data | Val mIOU |
|---|---|---|
| KITTI (baseline) | KITTI | 0.394 |
| Cityscape → KITTI | KITTI | 0.4338 |
| streetview-high-res → KITTI | KITTI | 0.3945 |
| streetview-low-res → KITTI | KITTI | **0.4014** |
| cameraview-high-res → KITTI | KITTI | 0.394 |
| cameraview-low-res → KITTI | KITTI | 0.3901 |
| complex → KITTI | KITTI | 0.3847 |

Table 1. KITTI Validation Results. The high-res and low-res refer to high resolution and low resolution. The cityscape training model performance should be the performance upper bound of the simulation-generated data trained model if the cityscape and synthetic dataset share the same dataset size and distribution.




## **Conclusion**:

1. Simulation helps, but the gap exists.

   Label Definition and Label Space.

1. Street view helps, but the camera view does not.

   Performance may be limited by the car's path and the camera's perspective from the car.

1. Low-Resolution Simulation works better!

   The details in simulation environment harm!

1. Over-complex environment is hard to learn.

   For a given environment, then just try to simulate the target environment.

   Towards a more robust model, we may need more complex and varied simulations. (less happened and labeled cases can be solved in simulation)

## **Further Work**:

1. Active Data Acquisition
2. Domain Adaptation Methods