
MACHINE LEARNING

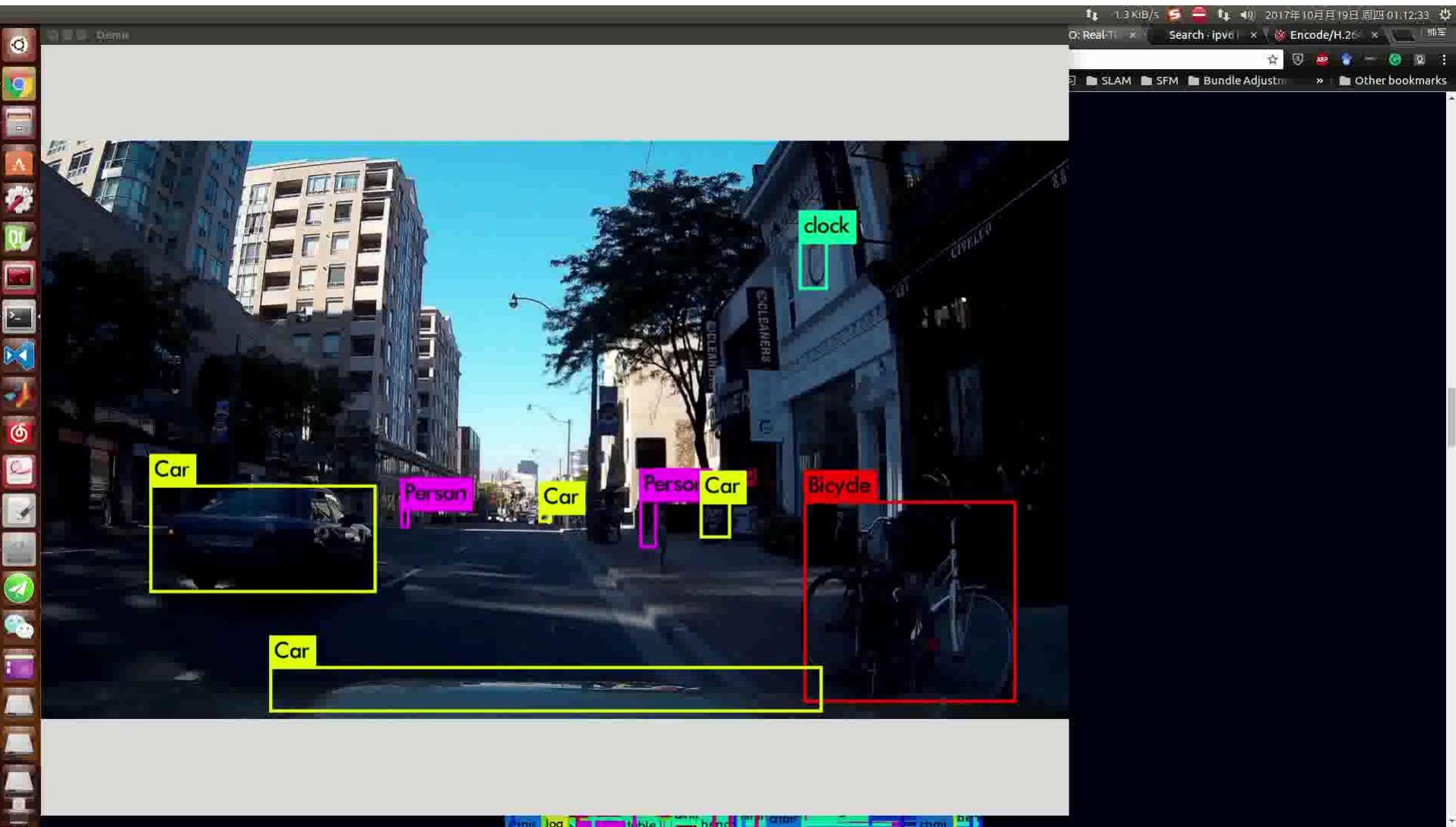
CHAPTER 0: INTRODUCTION

Outlines

- Framework
 - Problem Statement
 - Related Areas
 - History
 - Datasets and Learning Models
 - Optimization Methods
 - Algorithms
 - Examples
-

Our Lab: Center for Intelligent Transportation

Object Detection-YOLOv3



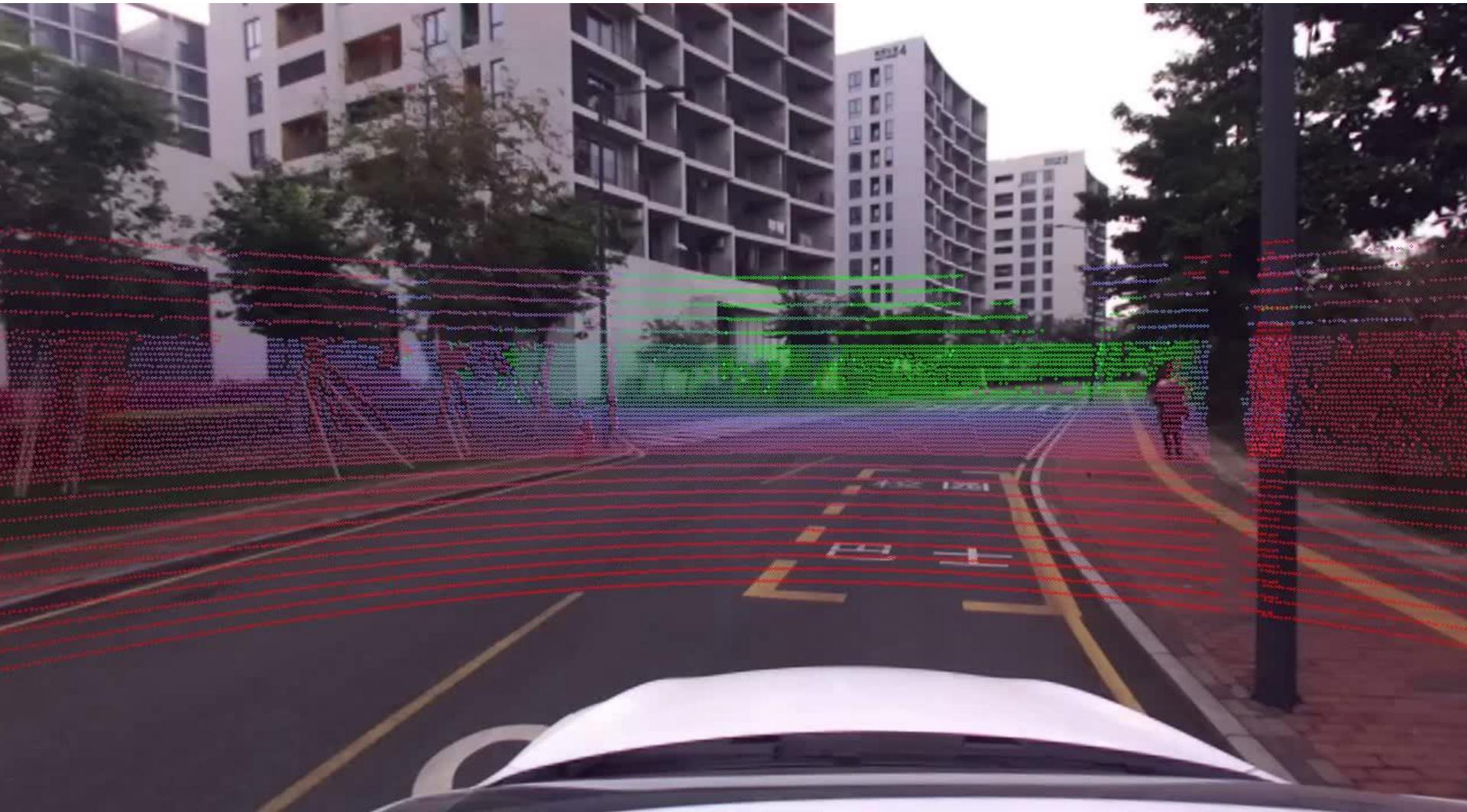
Instance Segmentation



Lane & Sign Detection



2D-3D Fusion



2D-3D Fusion for Tracking

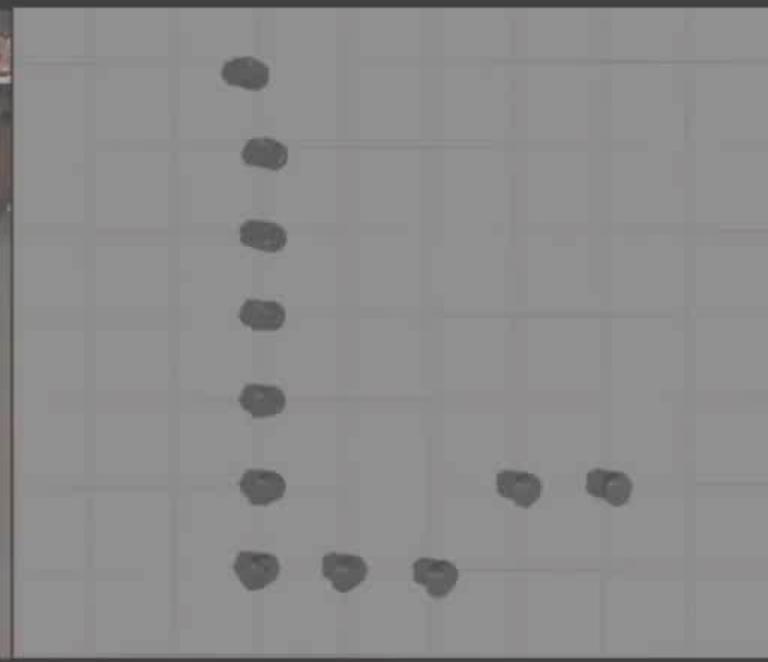
Joint Multi-Object Detection and Tracking with
Camera-LiDAR Fusion for Autonomous Driving

Kemiao Huang, Qi Hao*

Department of Computer Science and Engineering
Southern University of Science and Technology

Reinforcement Learning for Formation

2.5X



S U S T E C H

Reinforcement Learning for Navigation

Adaptive Environment Modeling Based Reinforcement Learning (AEMCARL) for Collision Avoidance in Crowded Scenes

Shuaijun Wang, Rui Gao, Chenyang Li, Shengduo Chen,
Ruihua Han, and Qi Hao*

Department of Computer Science and Engineering,
Southern University of Science and Technology

SUSTech Autonomous Driving Challenge

Autonomous Driving Challenge

demo video @南科大无人驾驶俱乐部

拓宽视野 模型蒸馏

Federated Learning for Map Fusion

Datasets and Benchmark Metrics

■ Datasets

- KITTI
- Udacity
- Waymo
- NuScences
- CityScapes
- ApolloScape
- SUSTech Scape



■ Metrics

- Correctness
 - Robustness
-

Our Dataset: SUSTech Scape

SUSTechscape

An open datasets for autonomous driving

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[Datasets](#)

[Download](#)

[Benchmarks](#)

[Simulator](#)

[Submit results](#)

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SUSTech Scape

Open Datasets for Autonomous Public Transportation with Smart Samples and Cyber-Physical Benchmarks

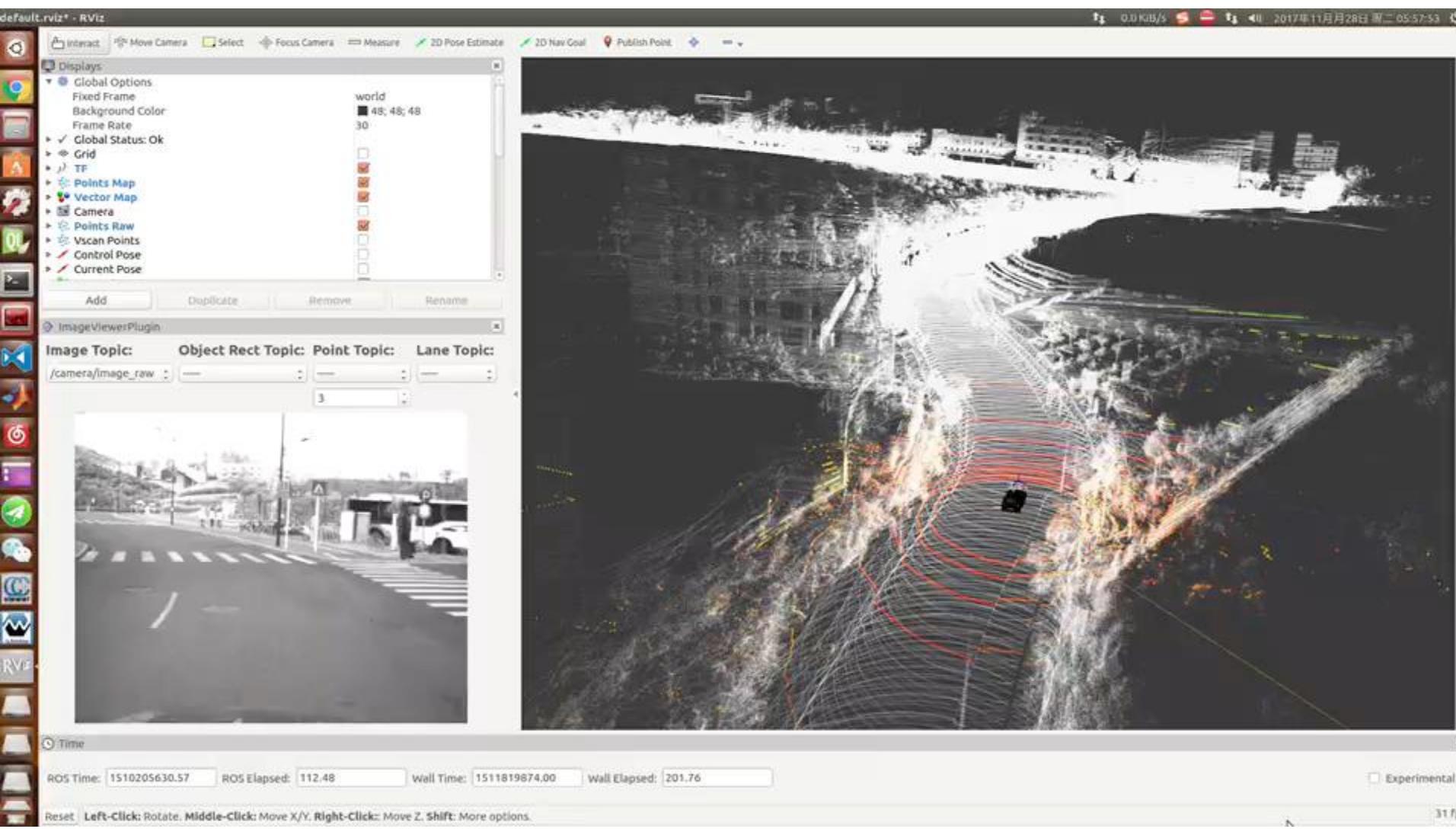


Datasets Comparison

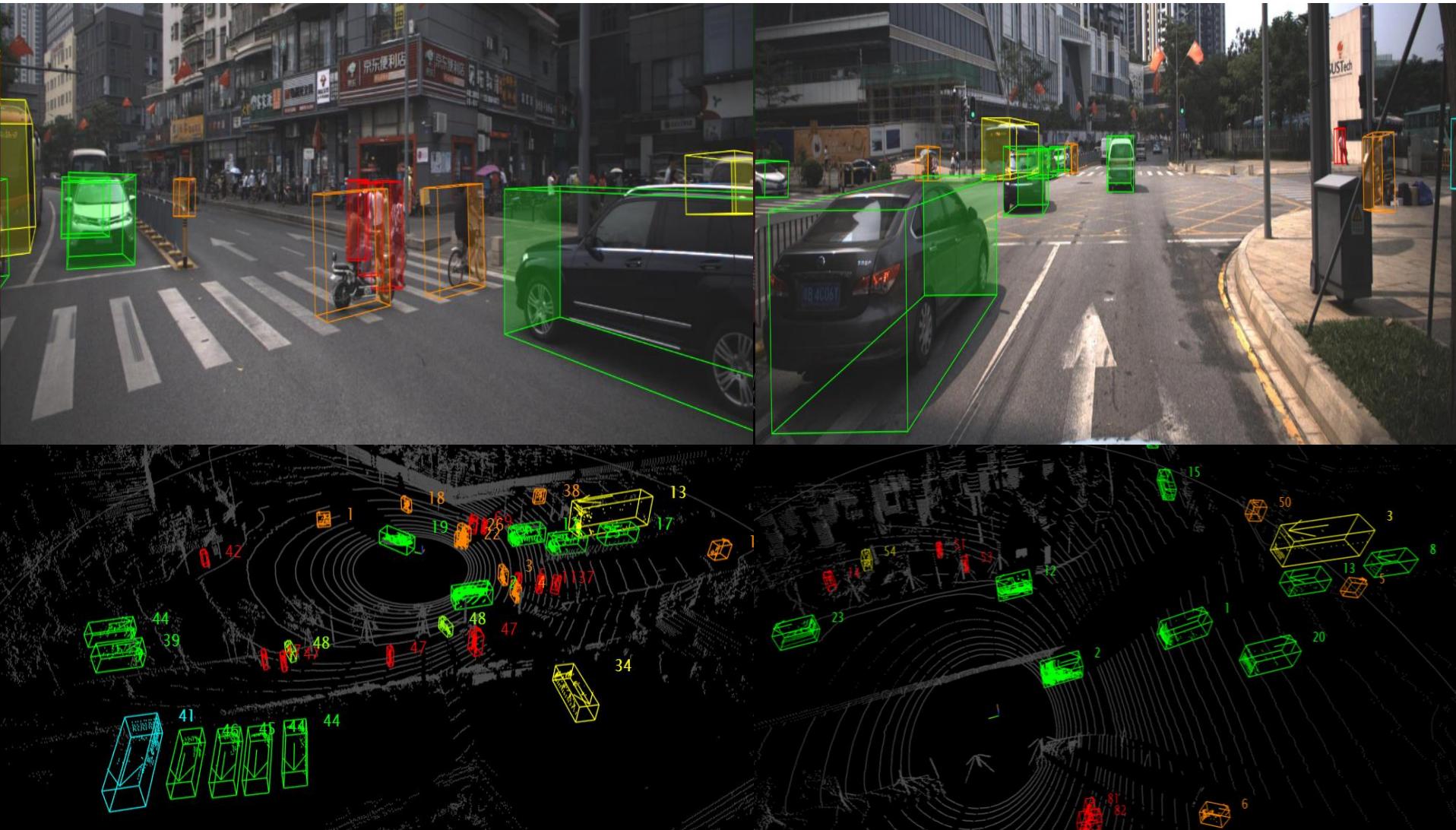
Dataset	Sensors	Location Accuracy	Scene Diversity	Annotation				Driver		
				2D	3D	Video	Lane	Behav	Physi	
KITTI	Cameras (6), Lidar (1)	cm	Regions Day time	box-15k, pixel-400	Box	no	no	no	no	
Oxford RobotCar	Camera, Lidar	unknow	1 City, weather	no	no	no	no	no	no	
TSD-max	Camera	m	Regions	box-10k	no	no	2D	no	no	
CityScape	Camera	unknow	50 Cities, Season, weather, D&N	pixel-25k	no	no	no	no	no	
Udacity	Camera, Lidar	unknow	1 City, sunny and overcast	box-25k	no	no	2D	no	no	
Mapillary	Camera	m	Cities, season, weather, D&N	pixel-25k	no	no	2D, 2 classes	no	no	
TorontoCity ¹	Camera, Lidar	cm	1 City	pixel	point	no	no	no	no	
BDD100K	Camera, Lidar	m	4 Regions, weather, D&N	box-100k, pixel-10k	no	no	2D, 8 classes	no	no	
ApolloScape	Cameras (6) Lidars (2) Cars (4)	cm	4 Regions, weather, D&N	pixel-140k resolution 2K	point	yes	2D, 3D, 28 classes	no	no	
SUSTech Scape	Camera Lidars (3) M-spectral Cameras (2) Buses (4) Taxis (4)	(6)	cm	1~5 Cities, weather, day and night	pixel-200k resolution <4K	point	yes	2D, 3D >28 classes	yes	yes

Comprehensive Evaluation of Autonomous Vehicle Perception Metrics						
Evaluation Metrics		Methods	Measures	Subjects		
Scene Processing	Scene flow	stereo disparity outliers [%] optical flow outliers [%] scene flow outlier [%]	Image, 3D Points Cloud Based Experiments	Optical and scene flow estimation errors, 3D reconstruction errors compared with ground truth	Optical flow estimation, scene flow estimation, 2D-3D reconstruction algorithms	
	Depth	Scale invariant error [%] Relative squared error [%] Absolute squared error [%] Root mean squared error [%]				
Mapping & Localization Accuracy	Mapping	iRMSE [1/km] iMAE [1/km] RMSE [mm] MAE [mm]	Odometry (IMU, Camera) Readings and 3D Points Cloud Based Experiments	Environment mapping and vehicle localization under various scenarios and conditions	SLAM, key frame selection, sensor fusion, optimization algorithms	
	Odometry	Translation errors [%] Rotation errors [deg/m]				
Energy Efficiency	Urban Area	Battery capacity [kW/h] Range [kM] Complete weight [t]	Testing Experiments	Current and power consumption of devices	Power modes, battery management and Scheduling algorithms	
	Suburb Area					
	Hybrid Area					
System Scalability	Task completion time [h] Task completion distance [km] MTCA [km] MTDA [h]	Simulation Experiments in Different Scales		Predicted system performances in different scales of the vehicle fleet	Communication protocols, group formation control, collaborative planning Algorithms	
System Reliability & Robustness	Scenarios Overlap Rate[%] One Pass Rate[%] Defect resolution rate[%] Pressure running time[%]	Simulation Experiments under Complex Scenarios		Sharp turns, degraded marks, faulty signals, reckless driving, sensor failures	Sensor perception, motion planning, decision & control algorithms	

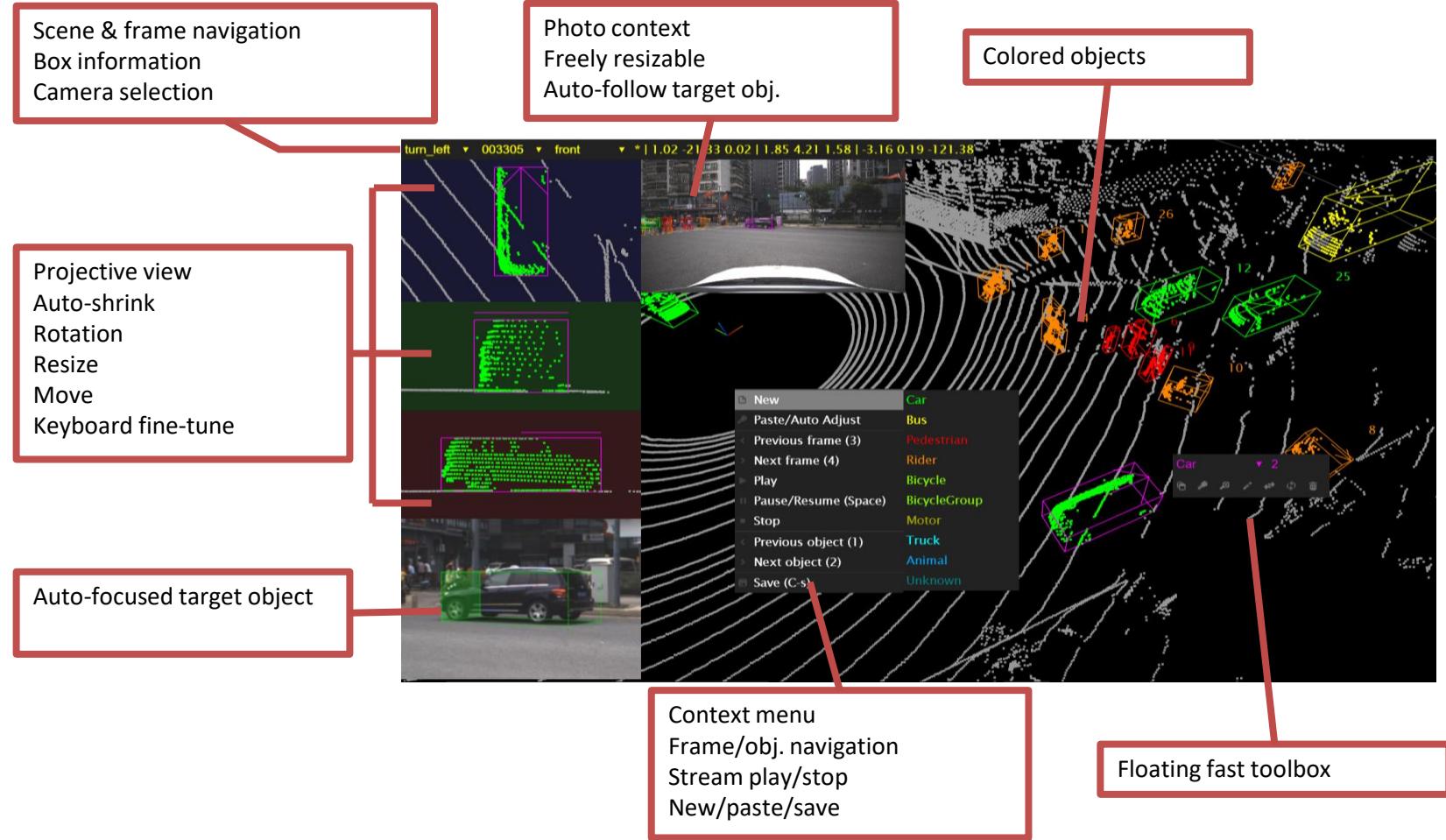
2D-3D Data



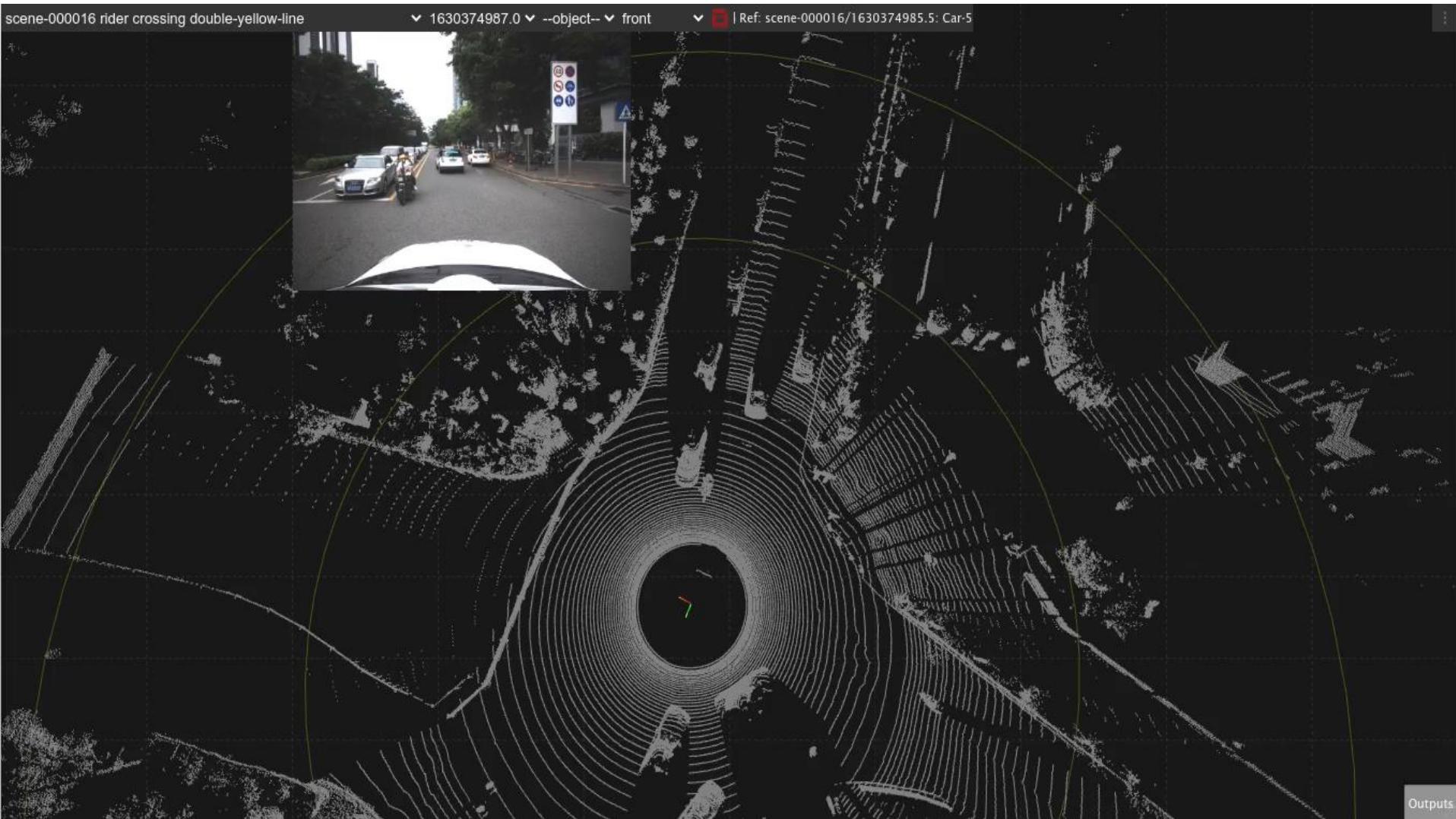
Dataset Annotation



Dataset Annotation Tools

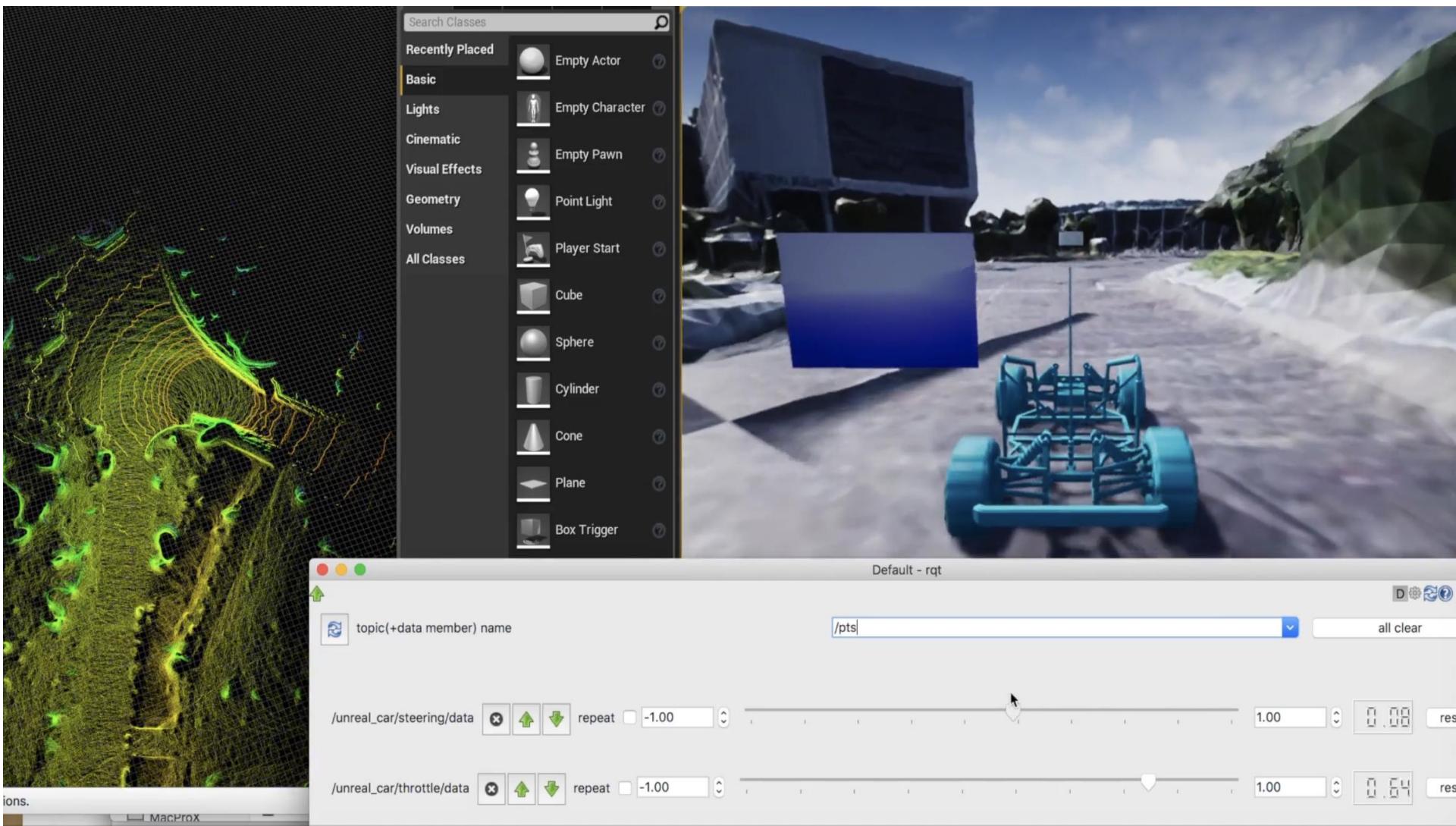


Out Platform: SUSTech POINTS



Outputs

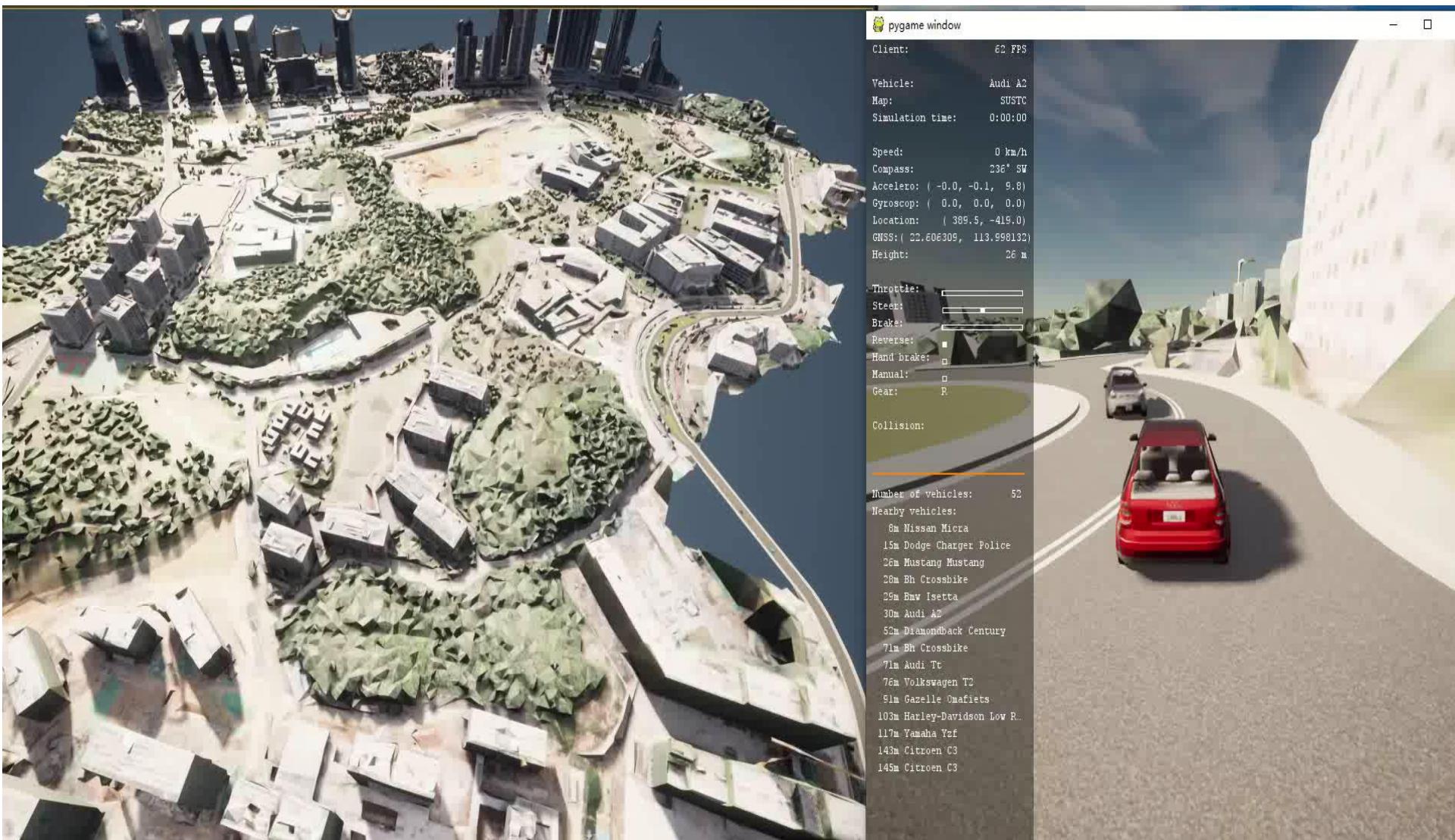
Out Simulator: SUSTech PAVALION



Simulator: CARLA+Autoware



Simulator: CARLA+Autoware



Simulator: CARLA+Autoware



More Reading and Multimedia Materials

Books: 《人类简史》 《奇点将近》 《终极算法》
《人工智能时代》 《2050》 《情感机器》
《数学之美》

Movies: “Blade Runner” “AI” “Prometheus”
“Covenant” “Ex Machina” “She”
“2001: Space Odyssey” “The Matrix”
“I, Robot” “Bicentennial Man”
“Terminator”

TV Series: “West World” “Humans” “Black Mirrors”

More Course Links

Stanford Machine Learning:

<https://see.stanford.edu/Course/CS229/47>

MIT Machine Learning: <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-867-machine-learning-fall-2006/index.htm>

Stanford CNN for Vision: <http://cs231n.stanford.edu>

Stanford Deep Learning: <http://cs230.stanford.edu/syllabus.html>

MIT Deep Learning: <http://introtodeeplearning.com/>
