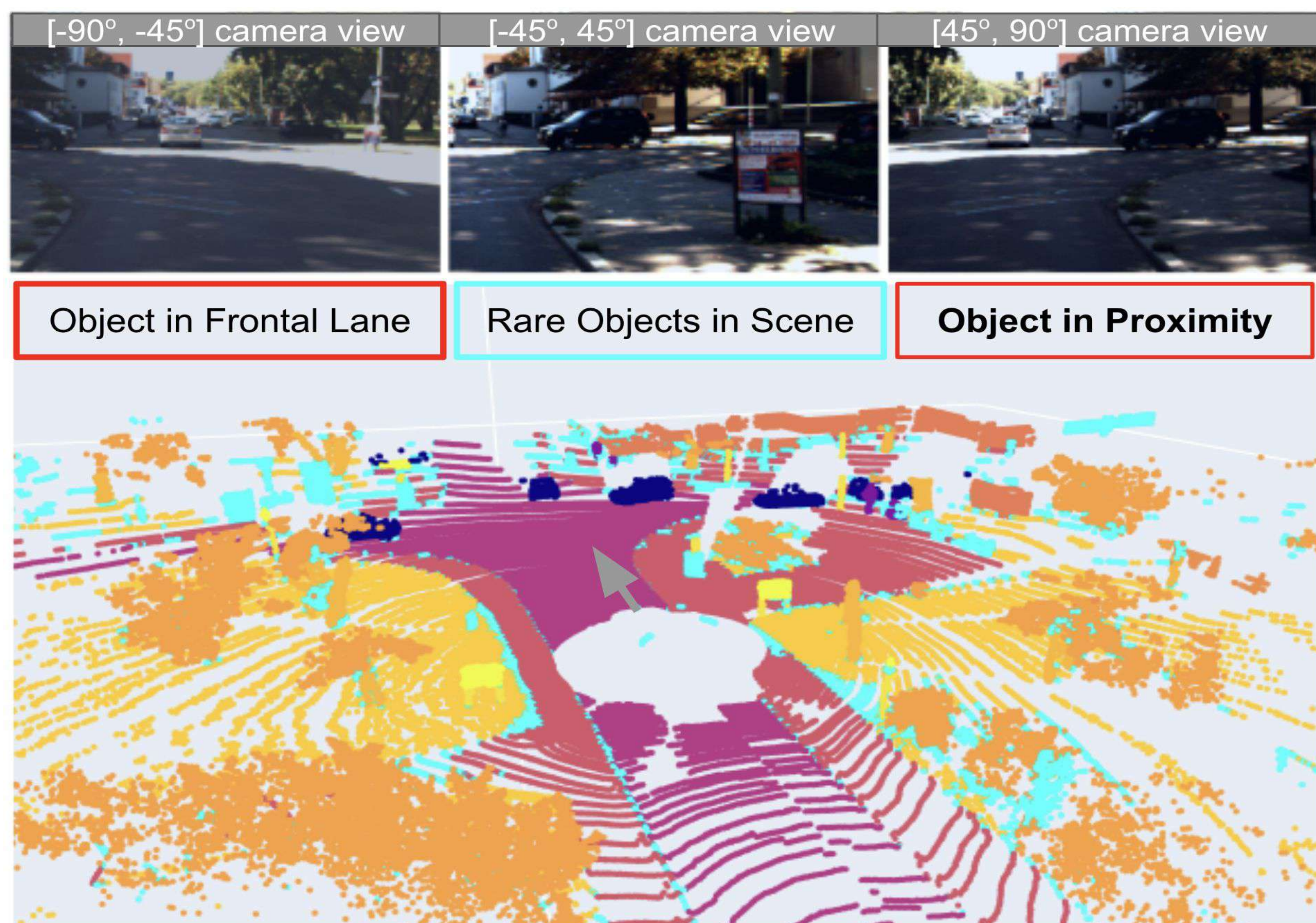


## Project Goals:

- Identifying Road Conditions(RC) via semantic understanding: parsing expected and unexpected/rare RCs, objects, and layouts

## Task Formulation:

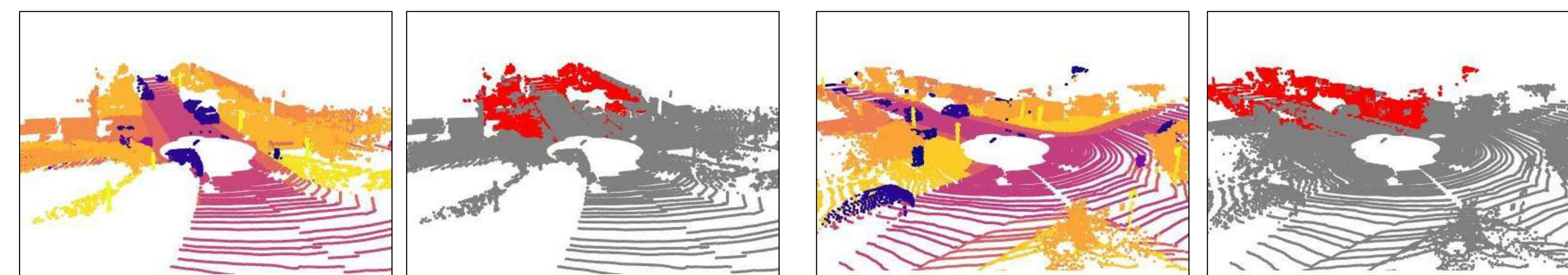
- Frame-wise RC identification and localization by point-level semantic segmentation and object-level detection
- Improving robustness of known points and objects
- Parsing unknown points and objects



## Rare Road Condition(RC) Frame Examples

- Frame-wise low-conf(< 0.5) points/all points > 30%

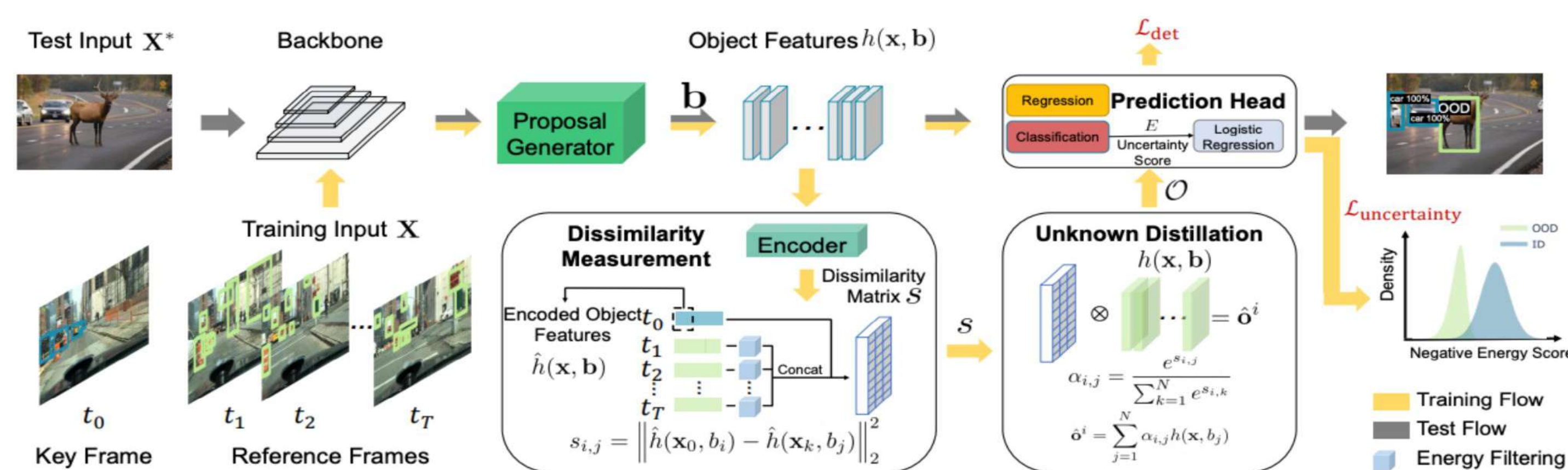
Semantic GT vs Low-conf Points Semantic GT vs. Low-conf Points



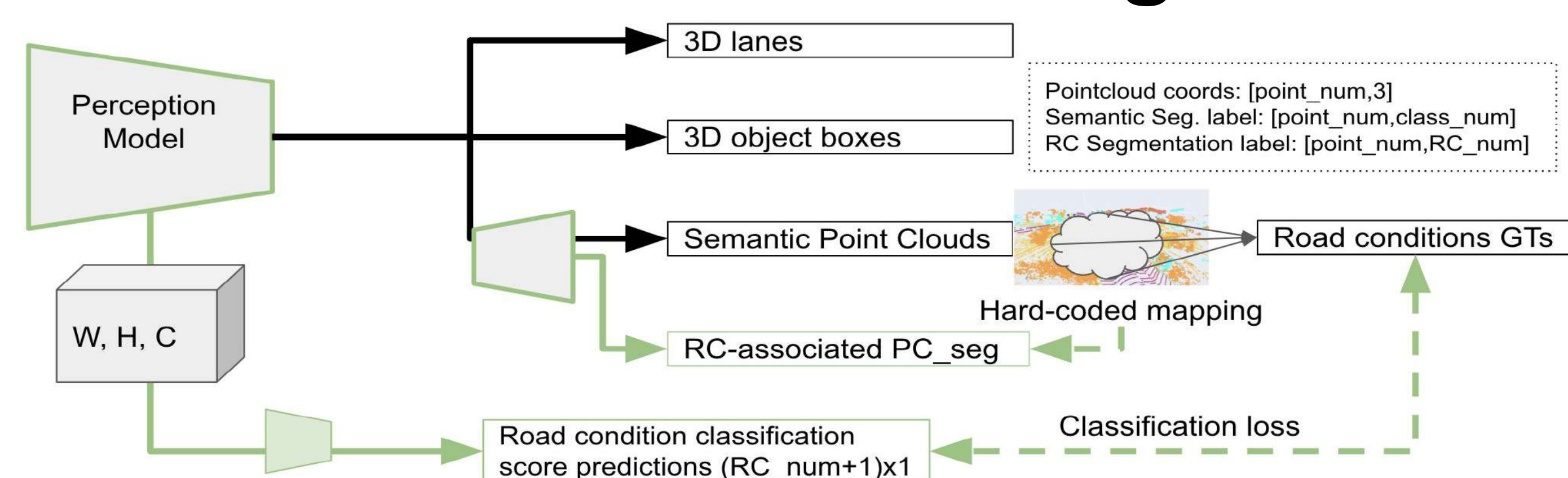
## Challenges 2: Rare/unknown objects with high detection confidences



**Baseline:** Unknown-Aware Object Detection: Learning What You Don't Know from Videos in the Wild, CVPR, 2022



## Our Solutions to Challenge 1:



- Preliminary results: Explicit RC-associated 3D point segmentation mIOU (extended from 2DPASS)

**OFL: 0.574 ROS: 0.386 OP: 0.512**

- Next steps: extremely imbalanced RC points
  - Balance each head with dynamic weight average
  - Leverage semantic scene information to introduce GT objects in a more realistic position

## Our Solutions to Challenge 2:

- Preliminary results: Discovering unknown objects that are inconsistent by temporal and distribution



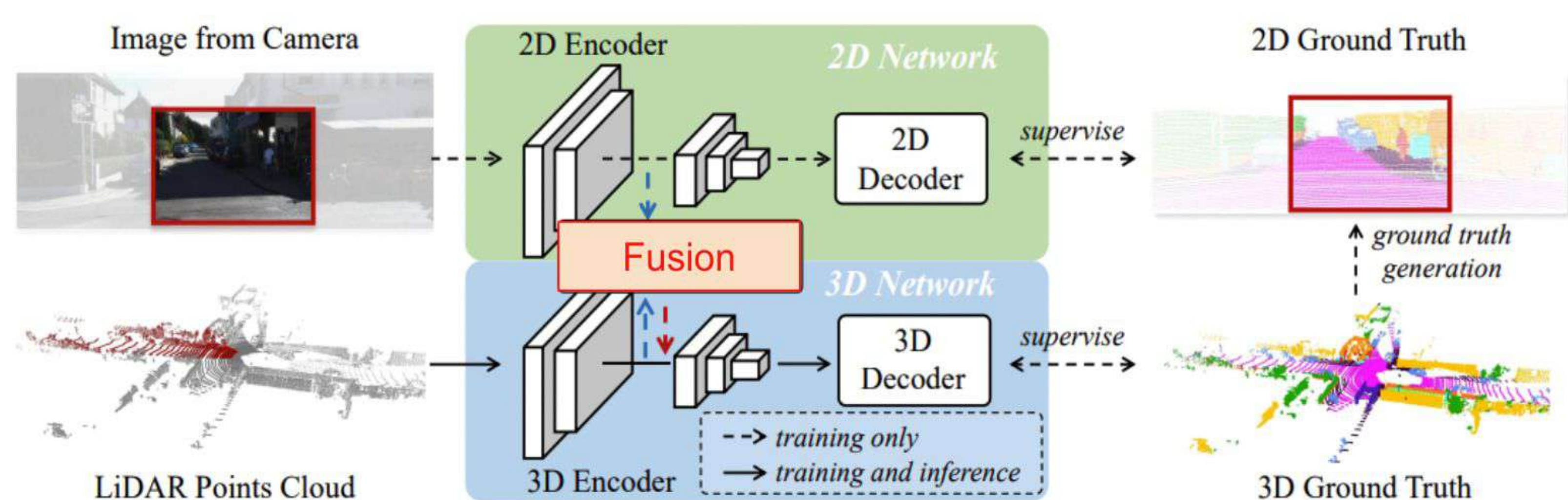
- Next Steps: rare object training data generation by Stable Diffusion and GPT4

## Preliminary results:

Hard-coded Points-to-RC mapping	RC1: Objects in Frontal Lane (RC from Predicted / GT points)	RC2: Rare Objects in Scene (Predicted low-conf points/ Offline low-metric classes)	RC3: Object in Proximity (RC from Predicted / GT points)
Frame-based RC F1-score	0.9320	<b>0.6704</b>	0.9480
Point-based RC mIOU	0.9025	<b>0.0314</b>	0.8771
Mapping time	0.0250 sec (CPU) 0.0021 sec (GPU)	0.0167 sec (CPU) 0.0016 sec (GPU)	0.0242 sec (CPU) 0.0021 sec (GPU)

## Challenges 1: Online-predicted low-conf points do NOT match offline-trained low-metric classes

- Baseline:** 2DPASS: 3D Segmentation on LiDAR Point Clouds Assisted by 2D Priors, ECCV, 2022



## Offline-trained low-metric classes on Semantic Kitti

	mIoU	car	bicycle	motorcycle	truck	bus	person	bicyclist	motorcyclist	road	parking	sidewalk	other-ground	building	fence	vegetation	trunk	terrain	pole	traffic-sign
2DPASS (val)	65.1	95.9	45.5	64.9	88.1	61.4	75.2	91.1	0.0	92.3	42.0	78.2	3.4	90.8	63.6	88.5	70.3	75.5	59.5	52.0