Continental
The Future in Motion

AI-based multi-sensor fusion for solving challenging driving scenarios

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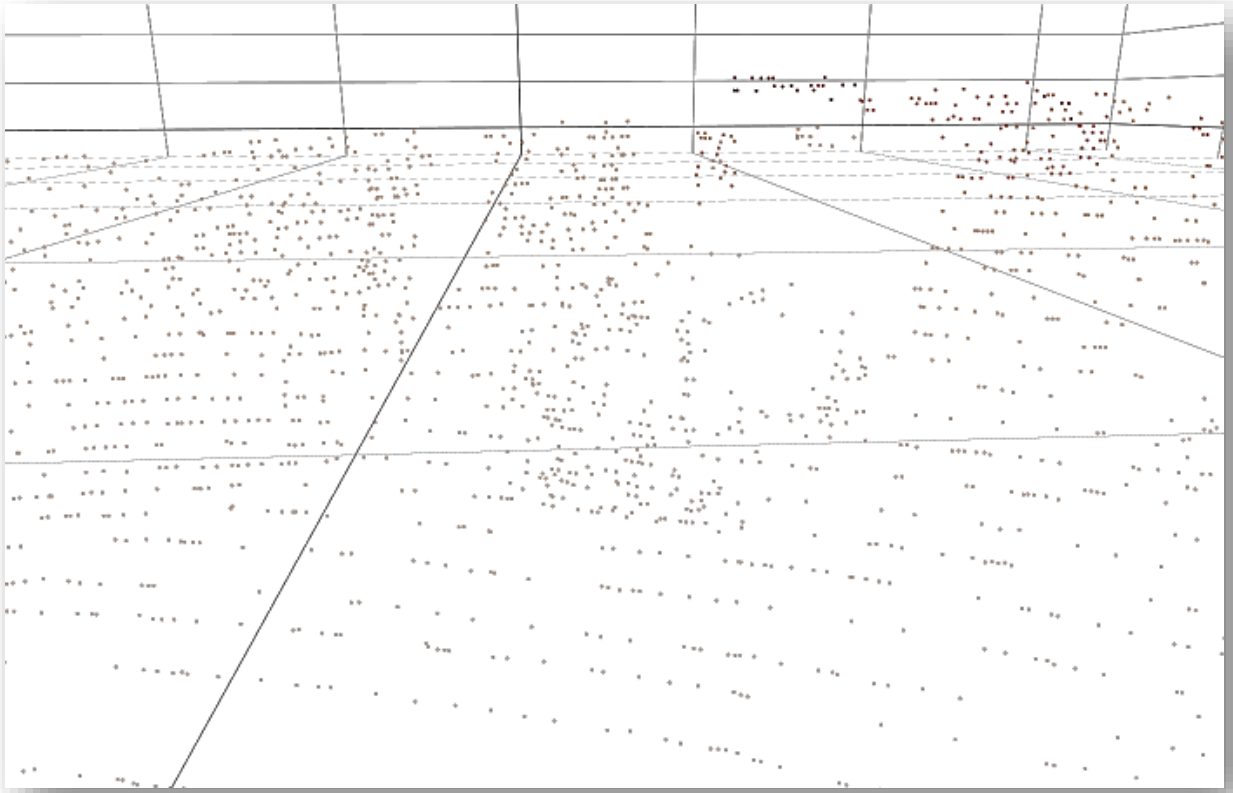
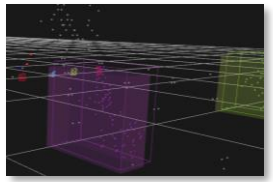
Continental

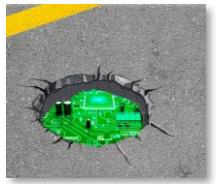


Goals and Real-world Challenges

Goals and topics

- Road safety is a priority
- LiDAR-Camera Fusion
- Enhanced Object Detection with colorized Point Clouds
- Robust localization of Traffic Participants





Assisted and autonomous driving

L0

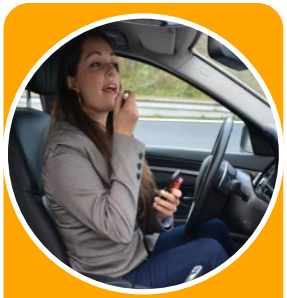
VOLVO BMW MAZDA VW TOYOTA Audi …

L1

VOLVO BMW MAZDA VW TOYOTA Audi …

L2

TESLA VOLVO BMW MAZDA VW TOYOTA Audi …



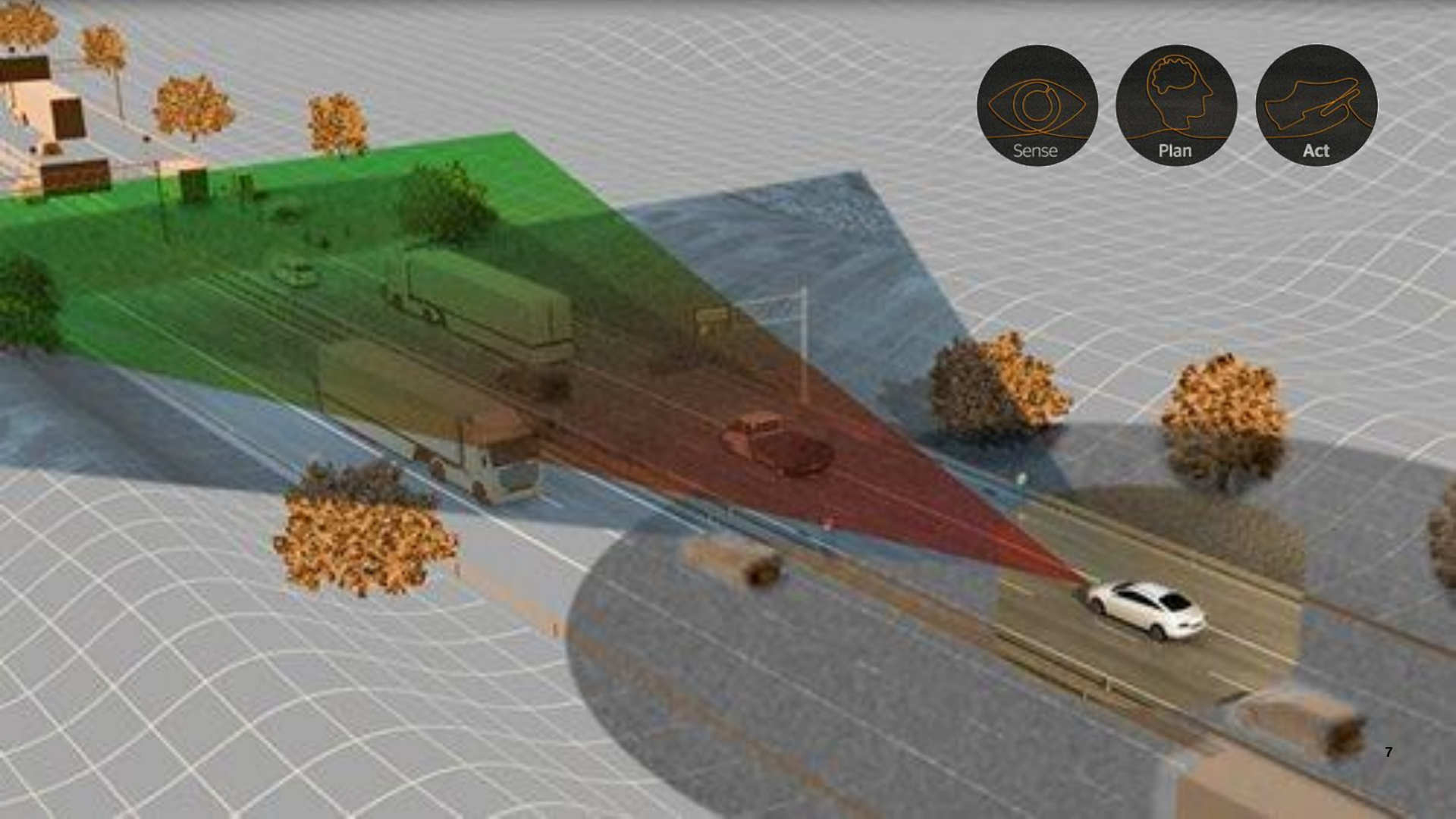
L3

HONDA

L4

WAYMO Uber

L5


Sense
Plan
Act

Real world Deep Learning challenges

› Fundamental difference in weather conditions

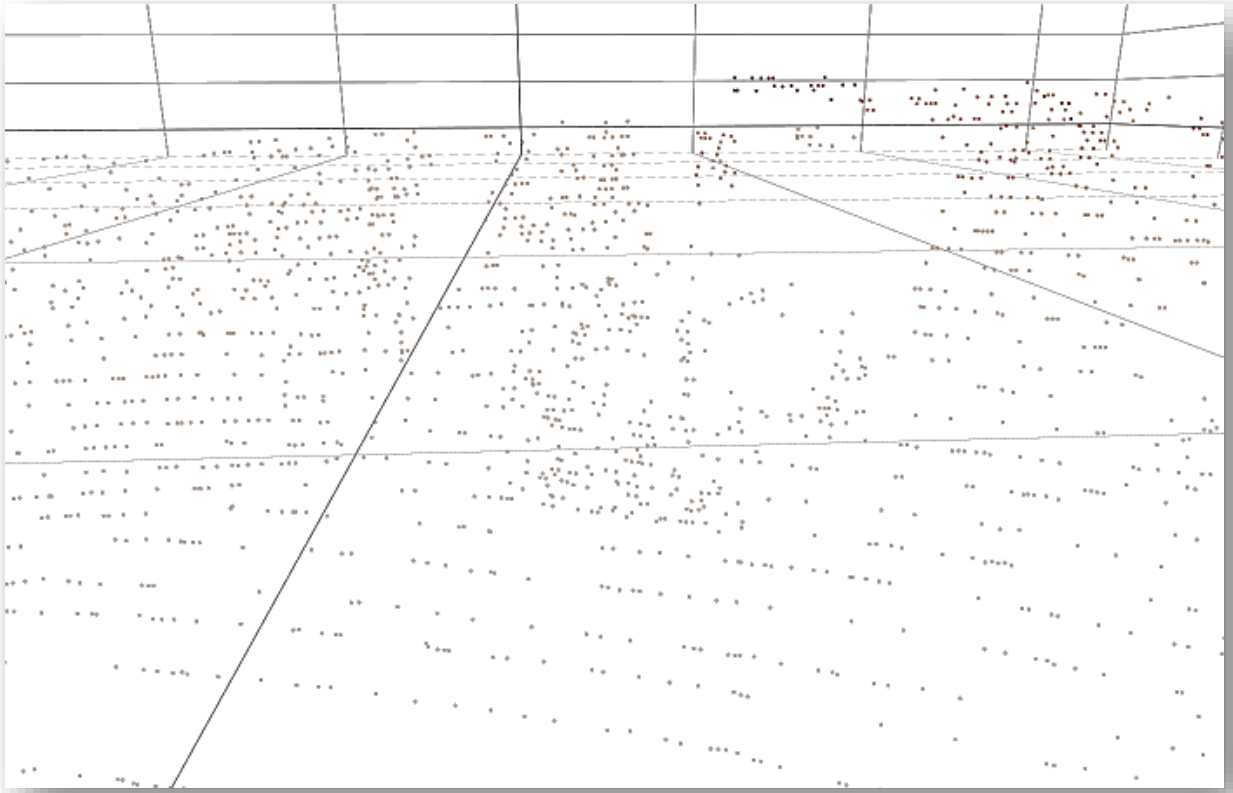
Precipitation

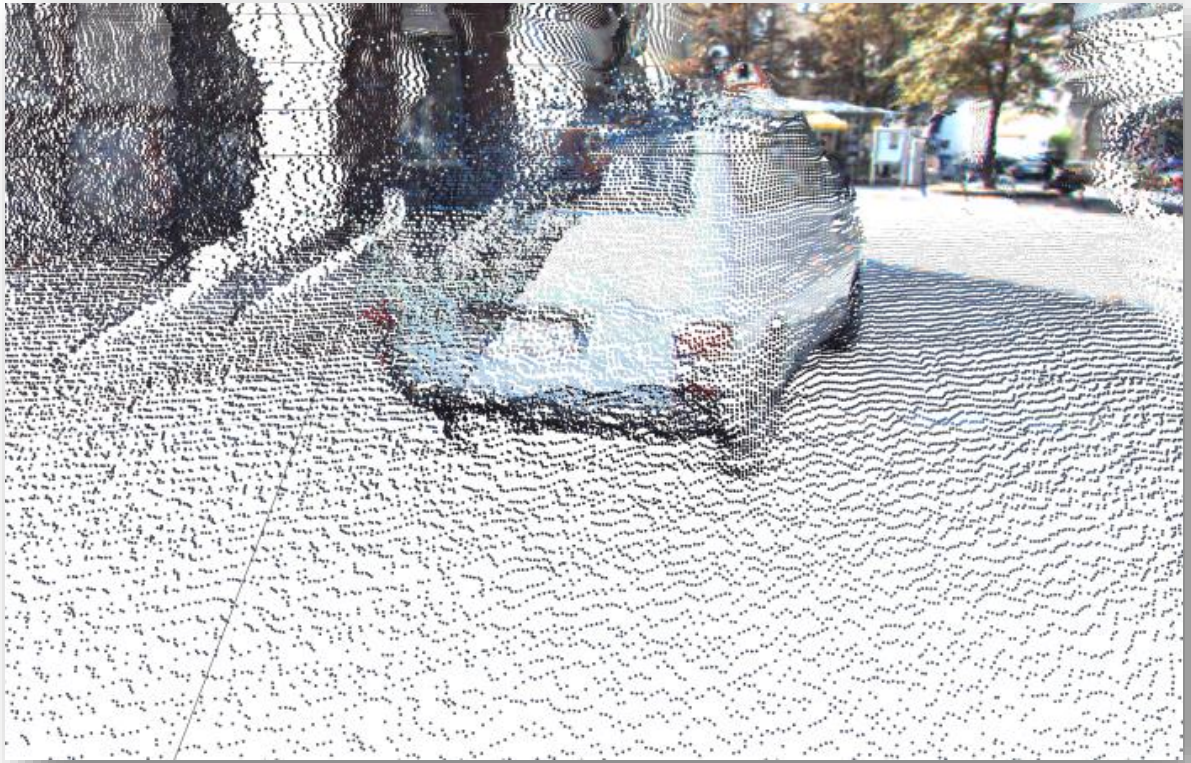
Visibility conditions

Real world Deep Learning challenges

- The real world is often too complicated and wild to be perfectly prepared.

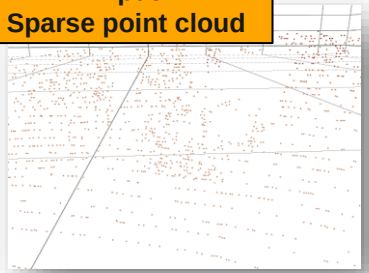
AI-based LiDAR-Camera Fusion





LIDAR-Camera Fusion using AI

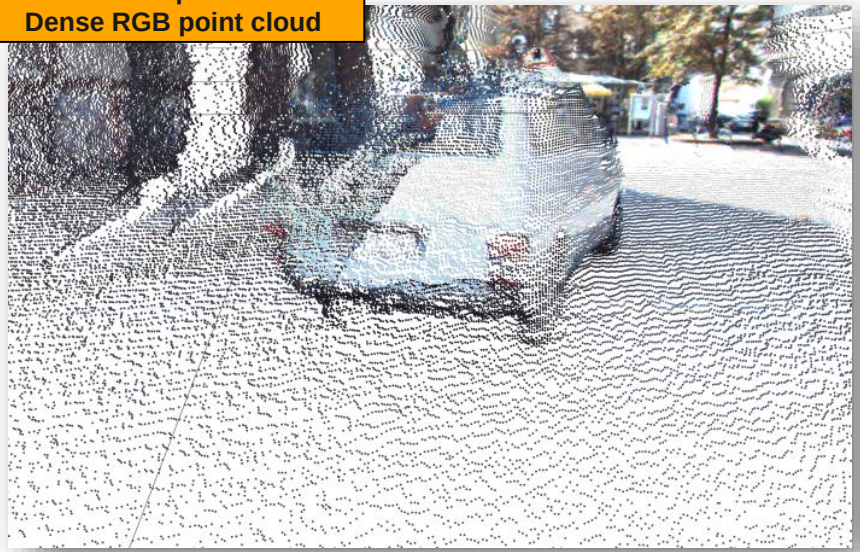
Input
Sparse point cloud



Input
RGB image

Fusion based
3D Reconstruction

Output
Dense RGB point cloud



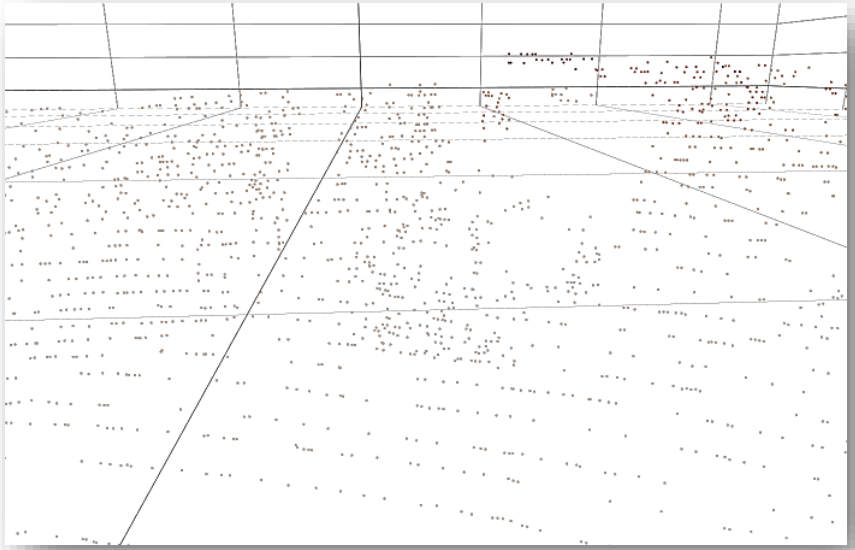
LIDAR-Camera Fusion - 3D Reconstruction

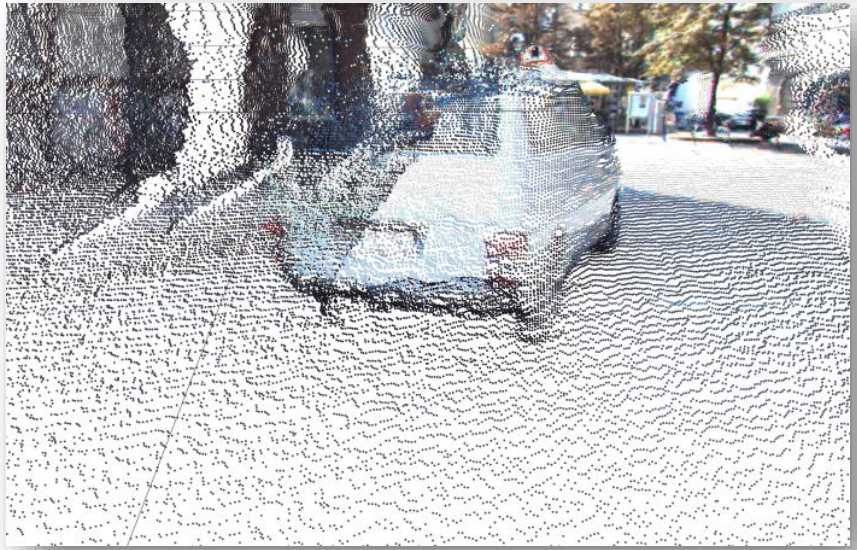
3D view of point clouds – a closer look

Input
Sparse point cloud

Fusion based
3D Reconstruction

Output
Dense RGB point cloud



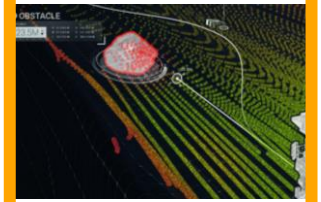


Camera-Lidar Fusion benefits

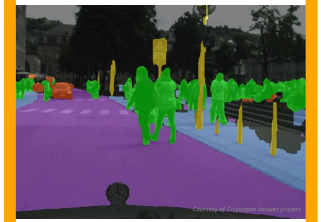
Distinguishing close by objects
(Object Detection)

Depth of potholes

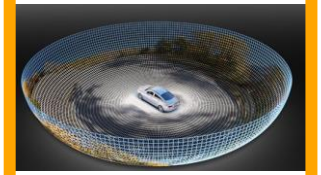
Height of obstacles



Distinguishing close by objects
(Semantic Segmentation)



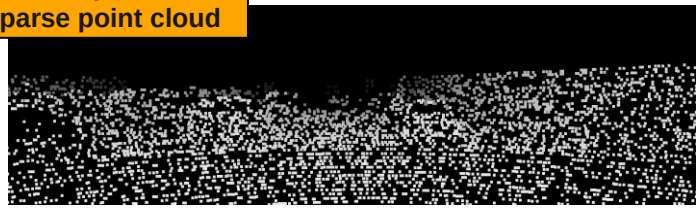
3D Environmental Mapping



Camera-LIDAR Fusion

100x LIDAR resolution upscaling

Input
Sparse point cloud

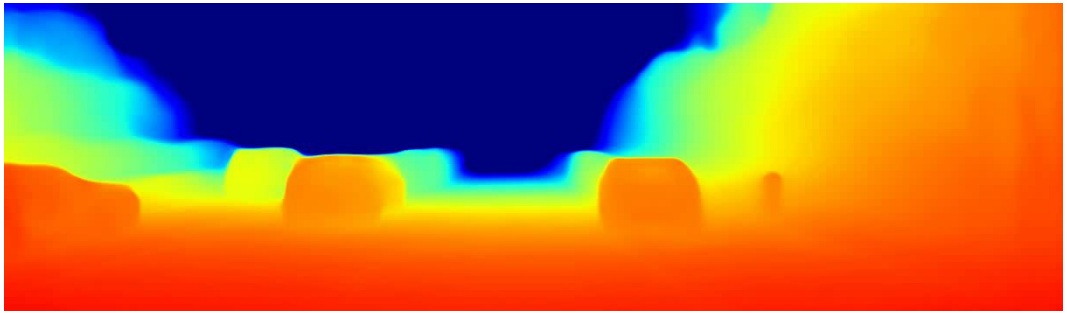


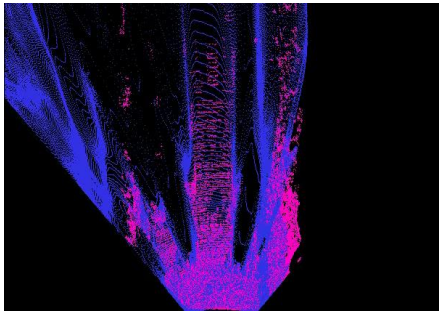
Input
RGB image

Output
Dense depth map

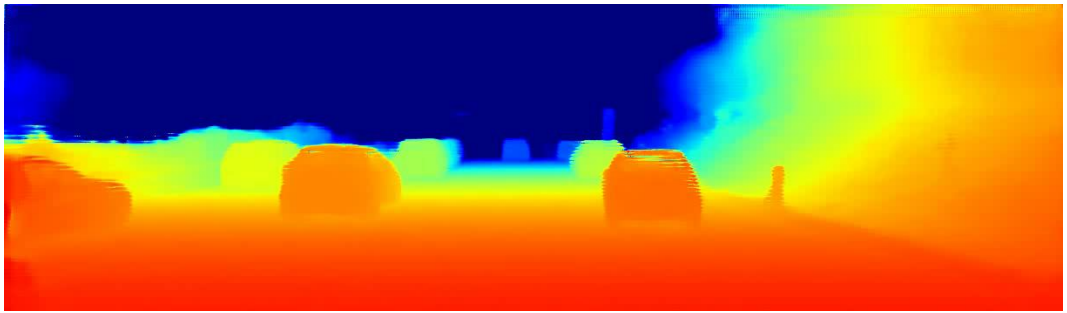
Demo – Comparison with Vision-only models

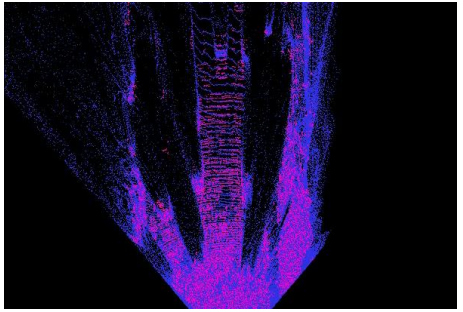
Camera Only
(Structure from Motion)



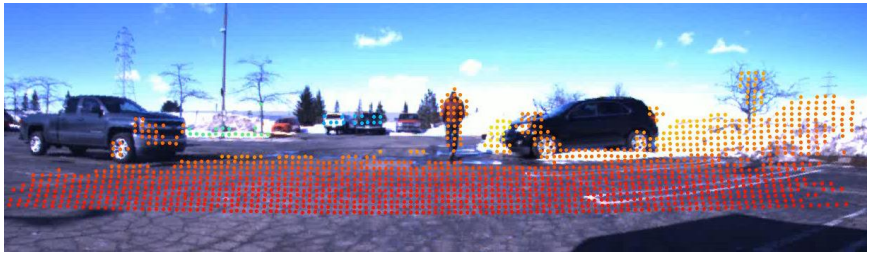
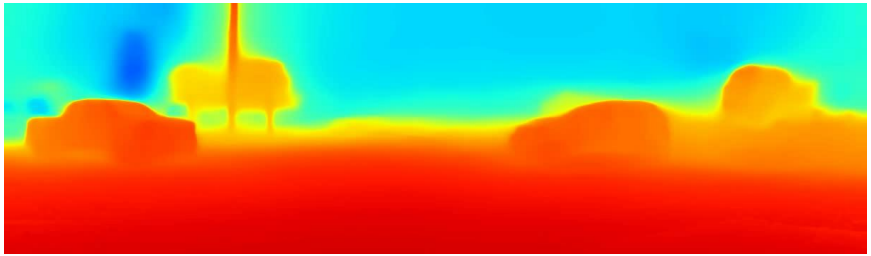
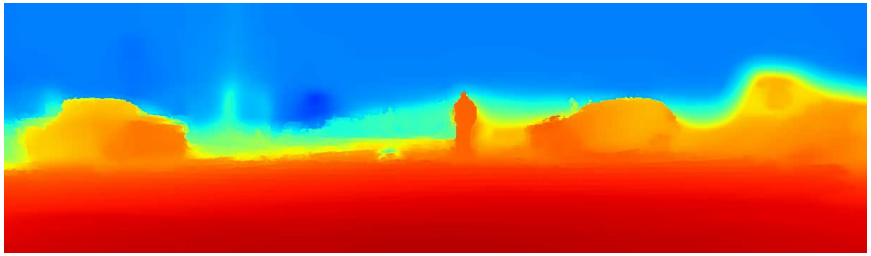


Ours
(Low-level Fusion)

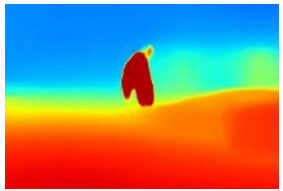
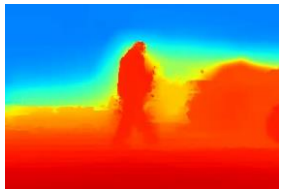




Demo – Comparison using automotive grade LIDAR

Sensor outputs	
Camera Only **(Structure from Motion)**	
Ours **(Low-level Fusion)** **(Refined)**	

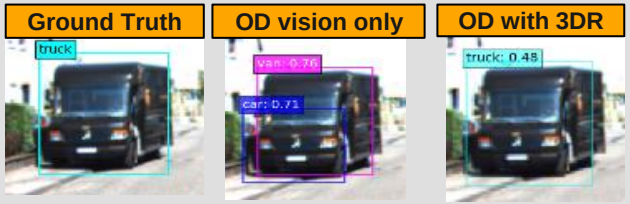
Robust localization of Vulnerable Road Users

Pedestrian visible on camera and lidar measurement		Ground truth location
Pedestrian partially missing on camera only output		Camera-only error: 73%
Pedestrian visible on our output		Fusion error: 0.5%

2D Object Detection enhanced with Fusion

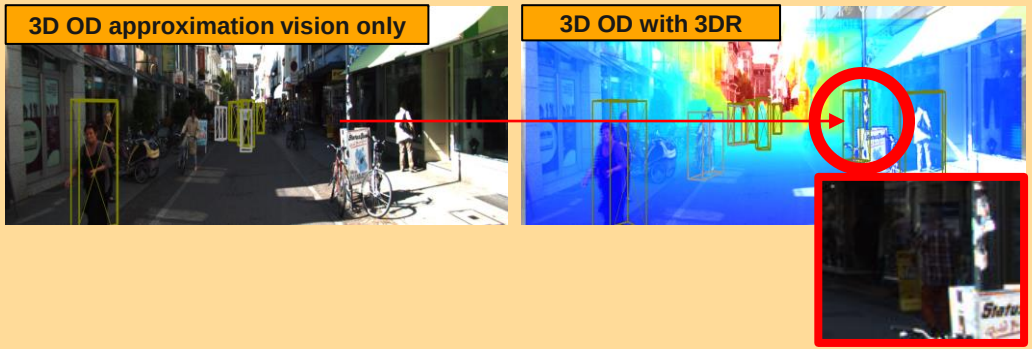
Saving cyclists and pedestrians

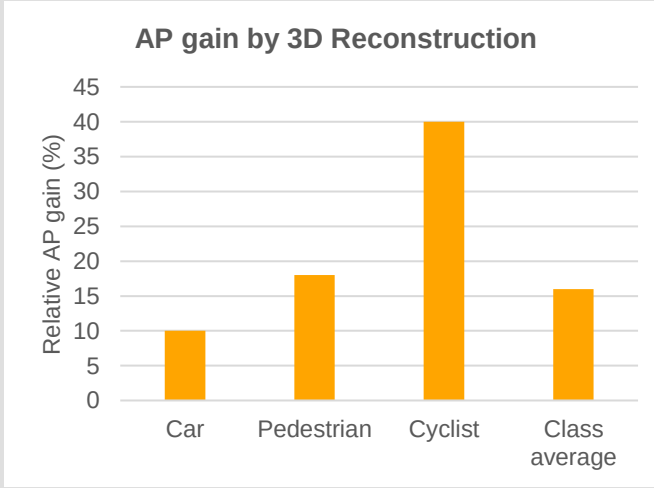
Classifying correctly



3D Object Detection enhanced with Fusion

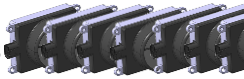
Saving cyclists and pedestrians





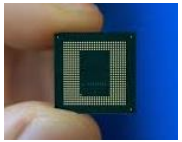
LIDAR-Camera fusion Summary

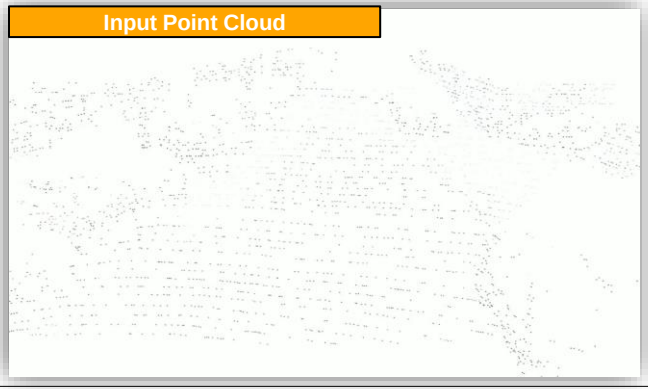
- Point cloud resolution enhancement: ~**100x resolution**

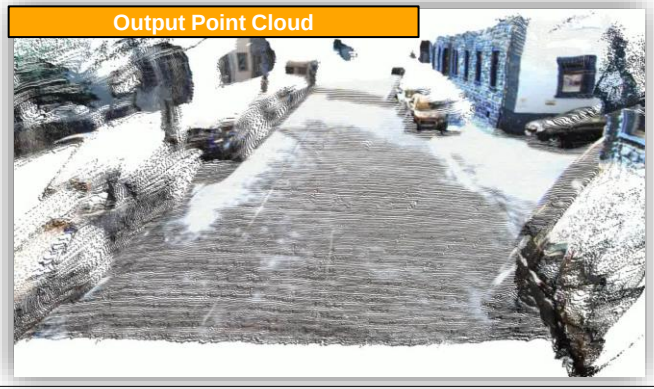
Solid state LIDAR 100x Solid state LIDARs 

- 3D localization errors from a **car length** to **less than a quarter car length**

- **Real-time** and fits on a small **embedded chip**







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