

# 3D LiDAR Point Cloud Loop Detection Based on Dynamic Object Removal

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**IEEE  
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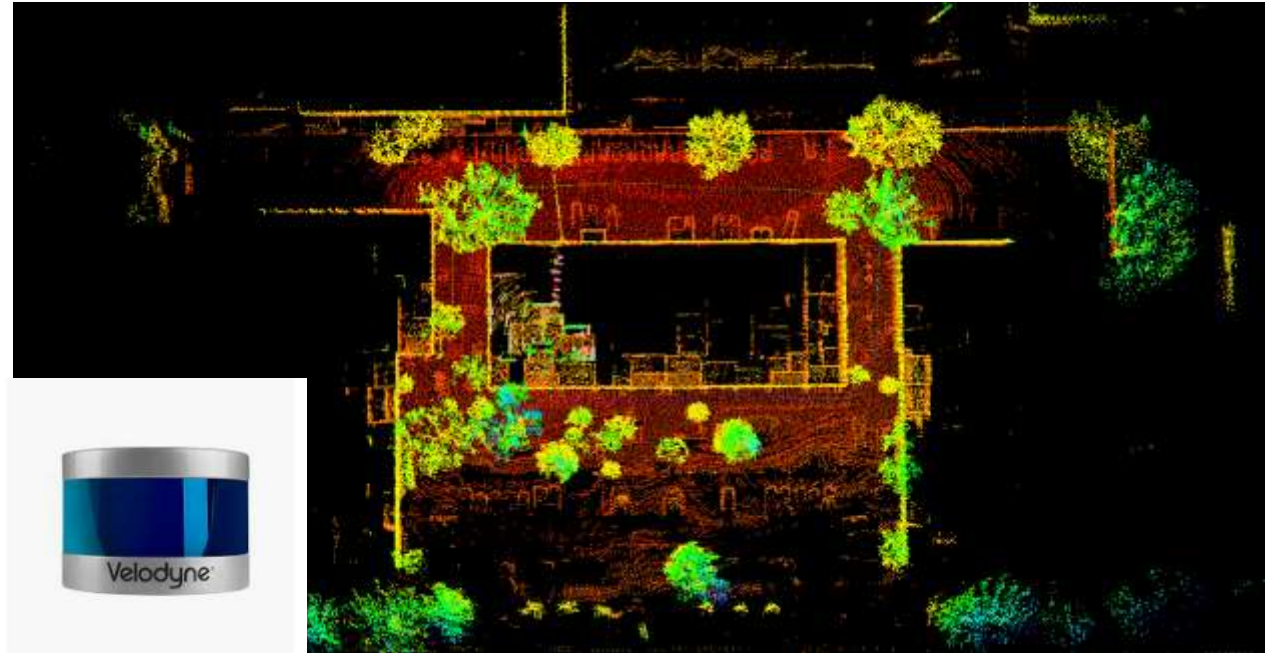
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04

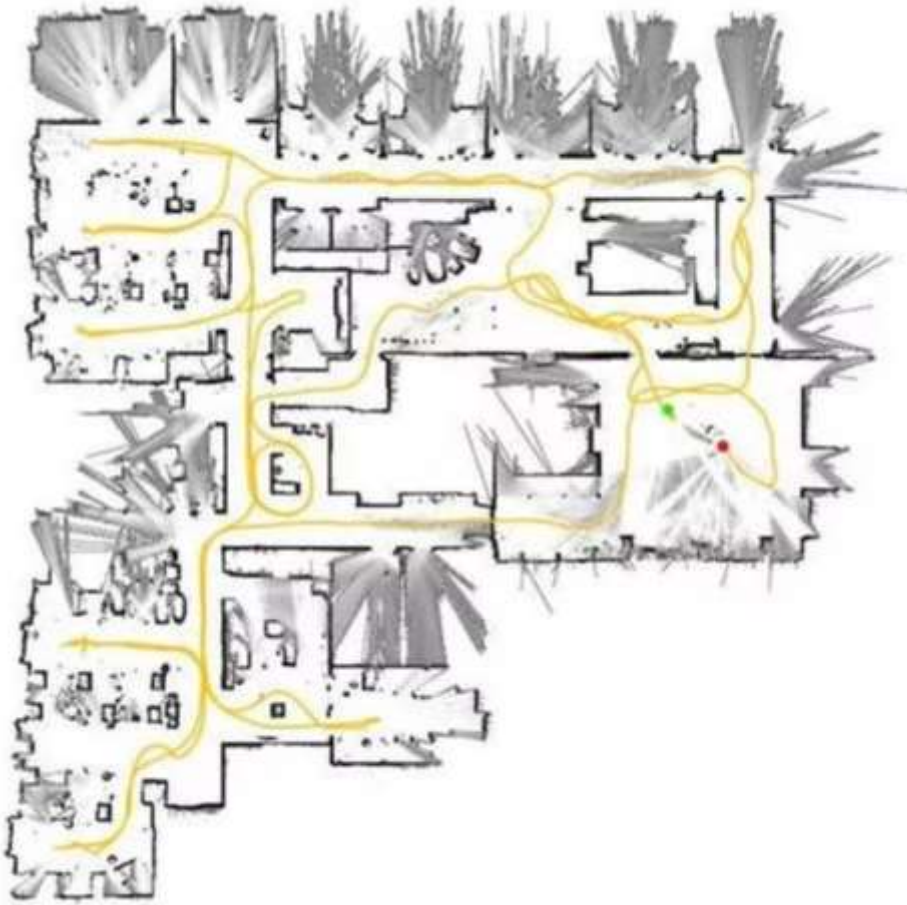
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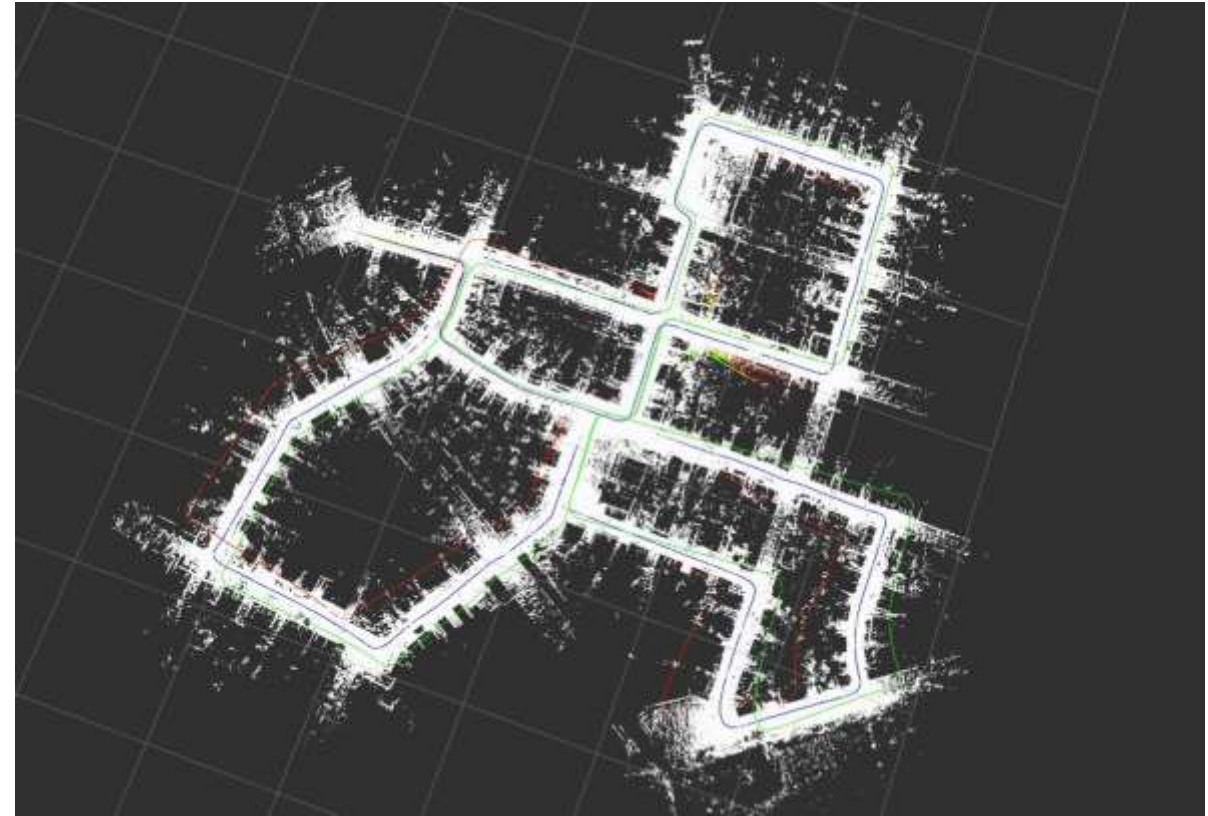
## Introduction



SLAM based on 3D LiDAR

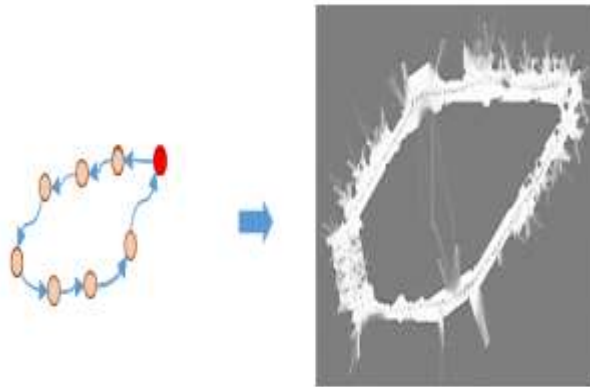
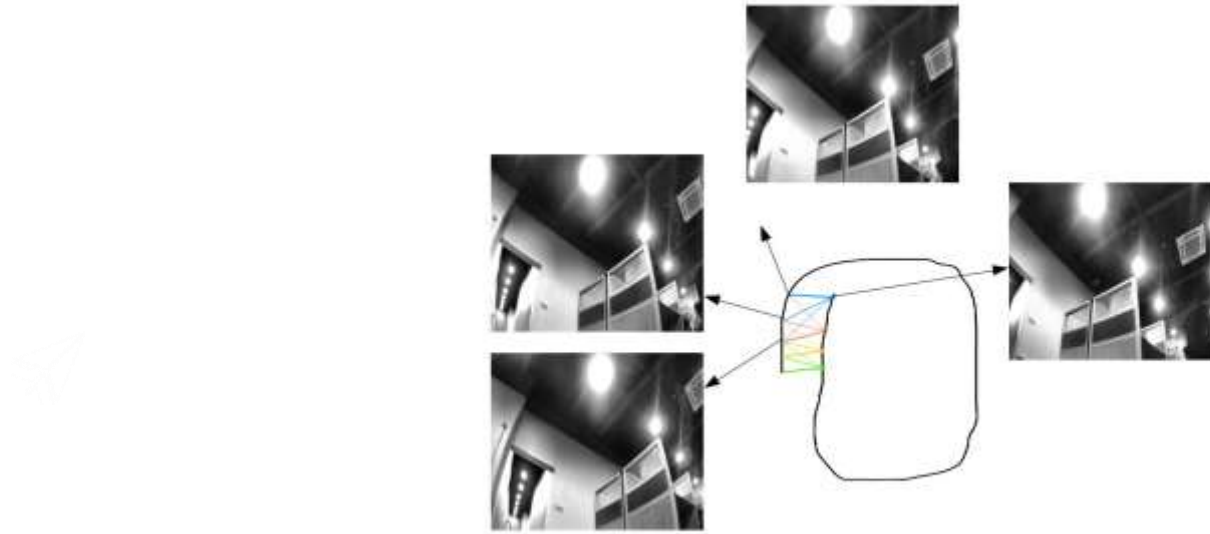


indoor scene map constructed by Cartographer

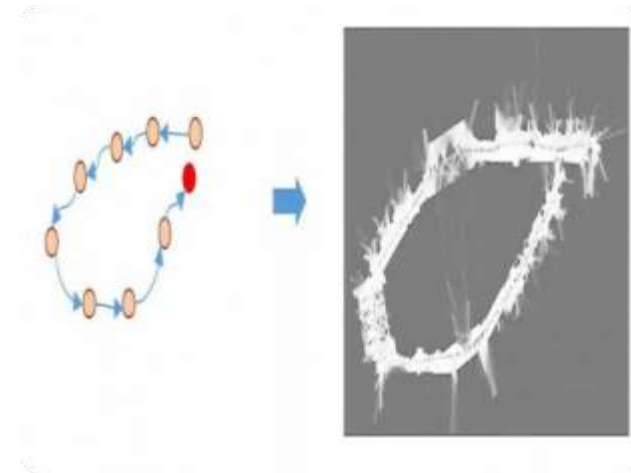


outdoor scene map constructed by LOAM

# Loop Detection

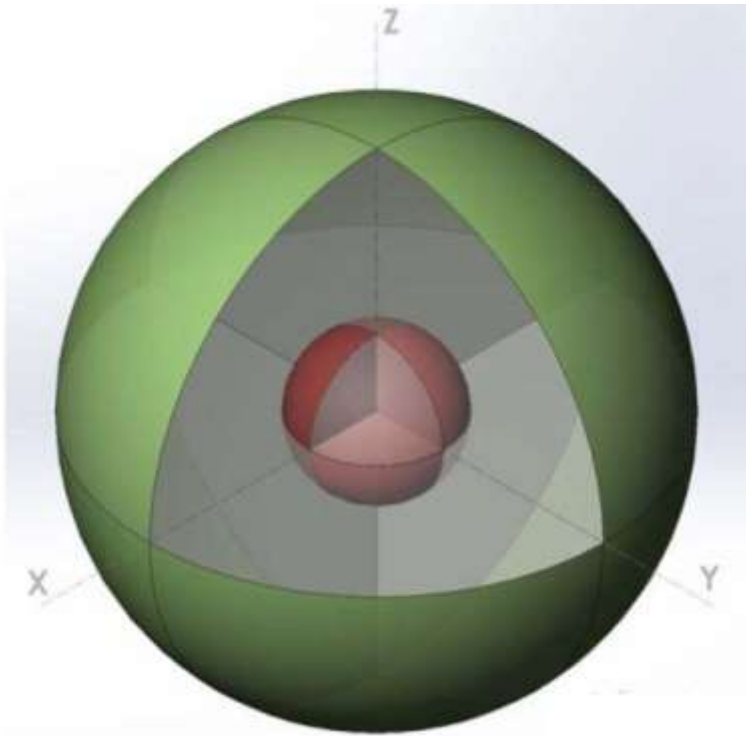


**successful loop detection**

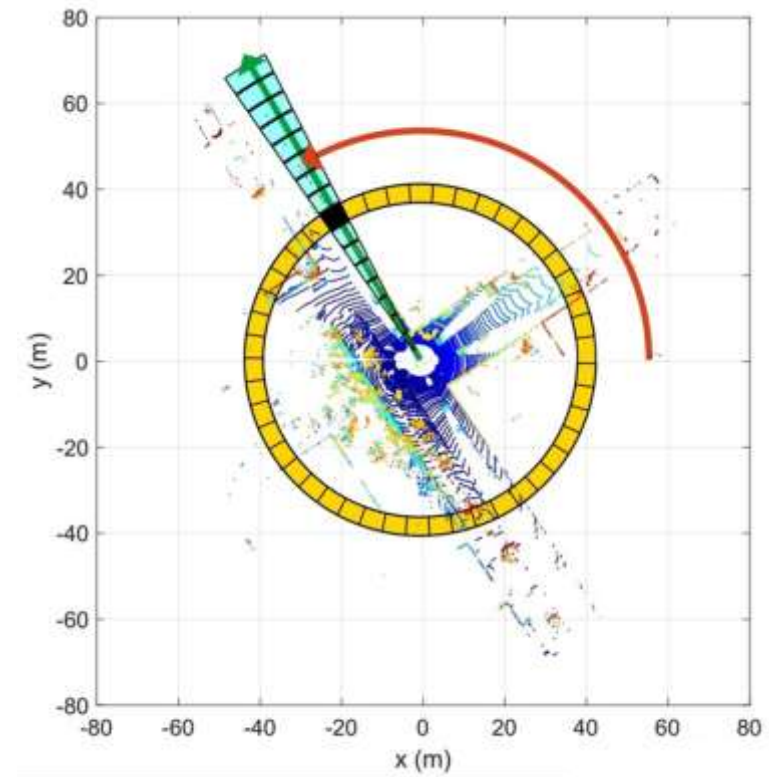


**failed loop detection**

## Related Work



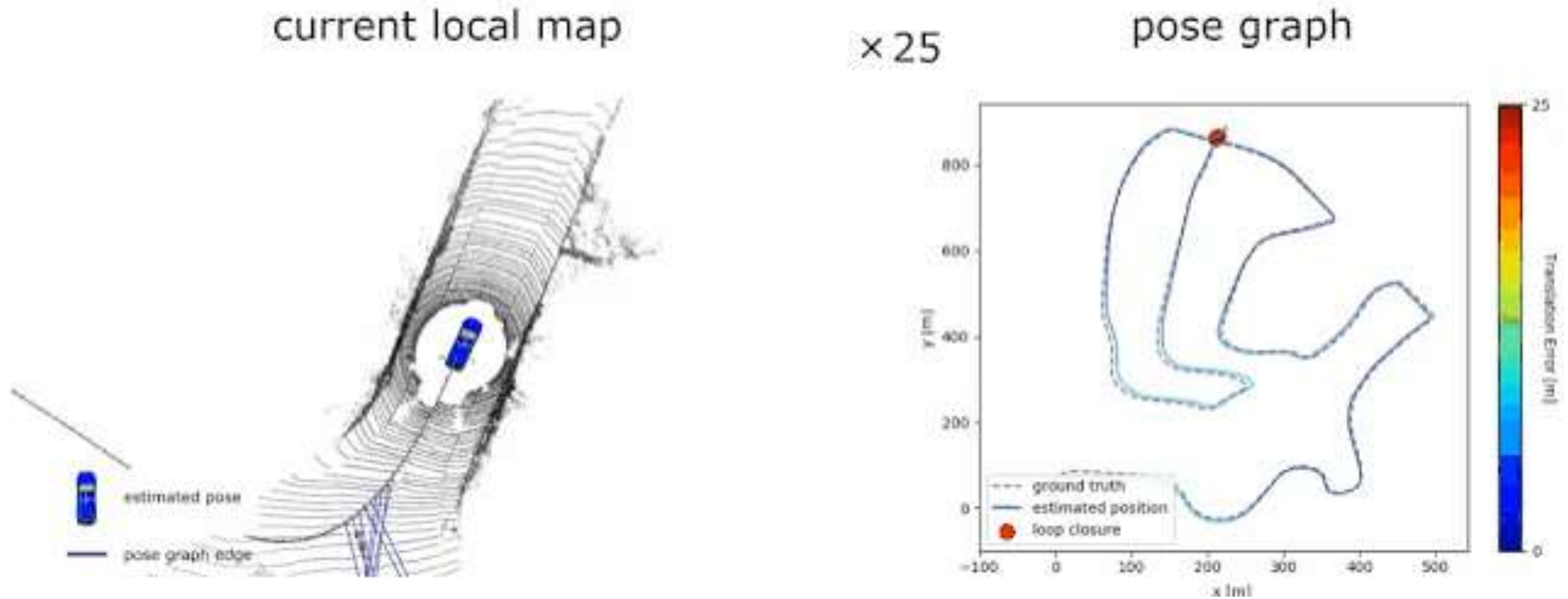
Structural division of the  
DELIGHT descriptor



Structural division of the  
Scan Context descriptor

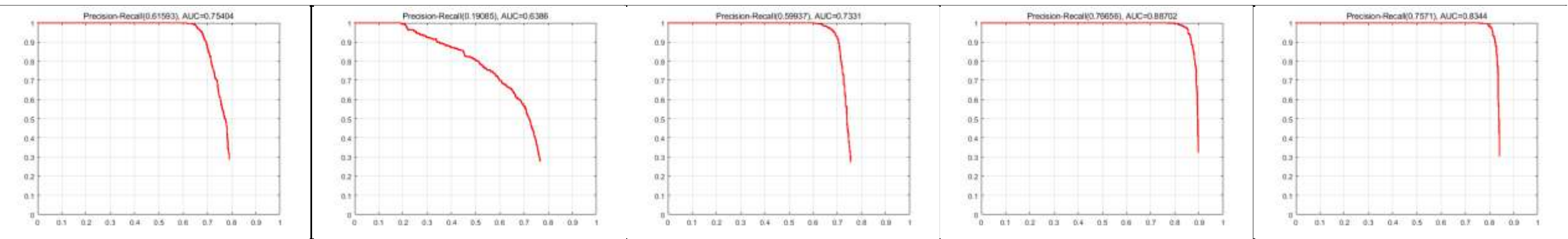
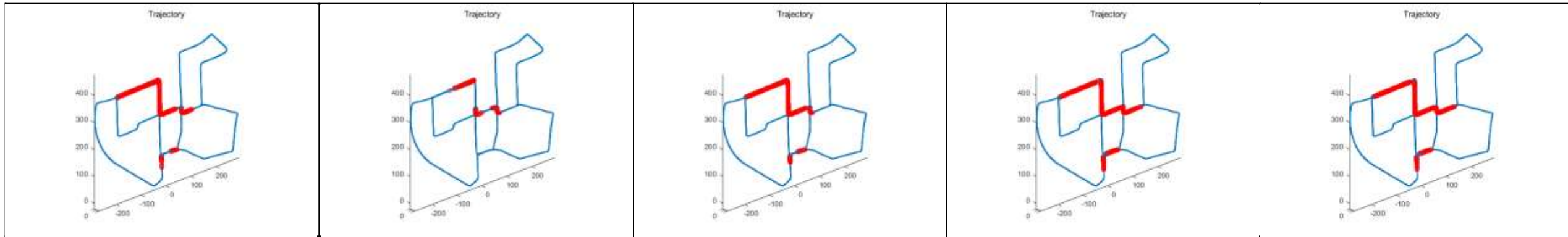


## Closing Loops for 3D LiDAR SLAM



Semantic-based loop detection : OverlapNet

## KITTI 00



Delight

M2DP

Scan  
Context

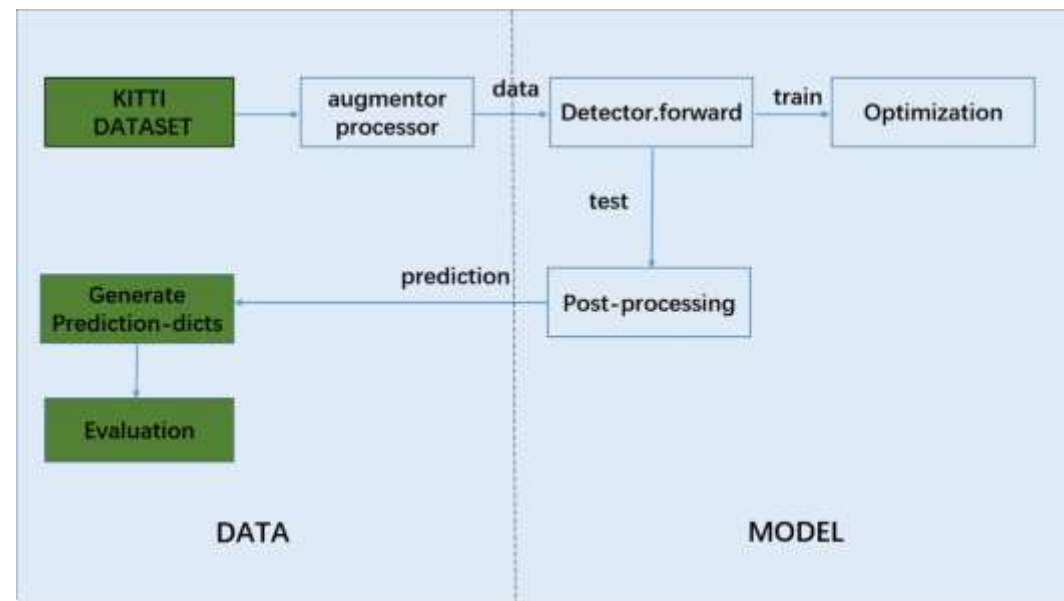
BoW

GIST



03

## Methodology



OpenPCDet's framework

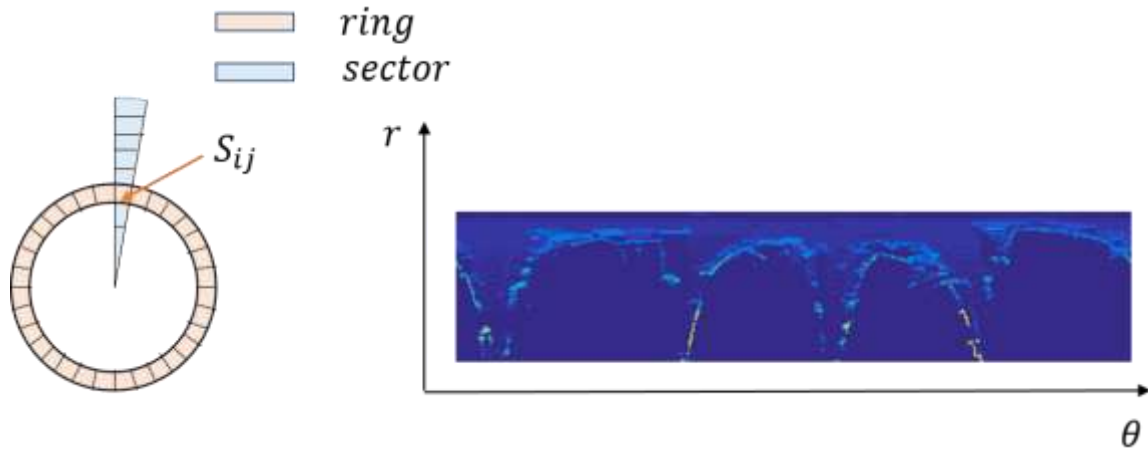
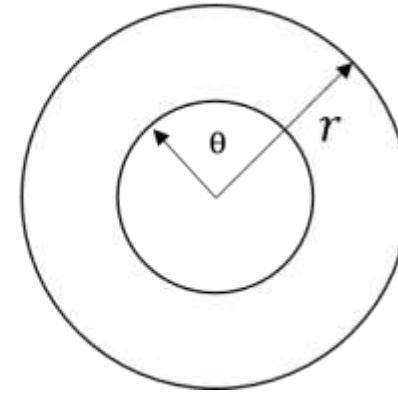
# Dynamic Object Removal

3D bounding box



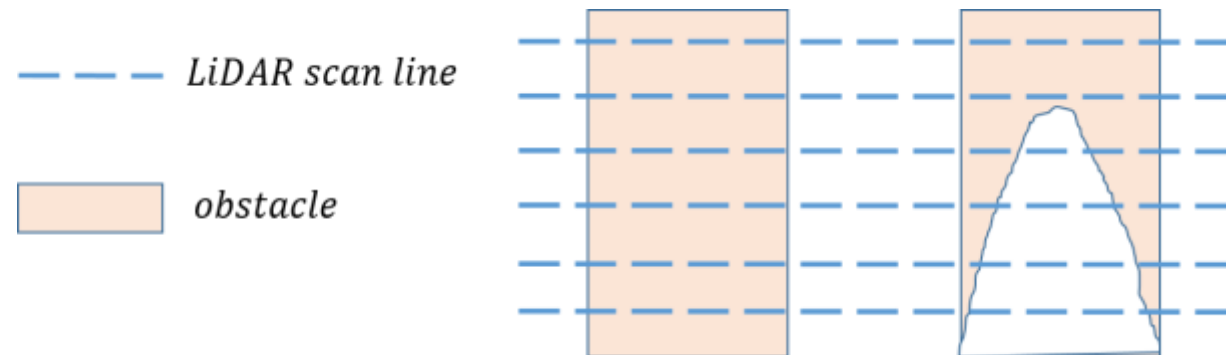
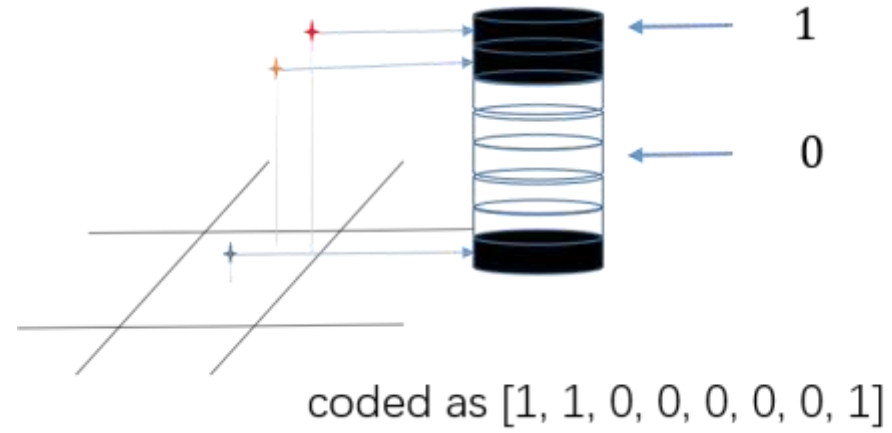
Data	Description
1	type of object
2	whether the object is truncated
3	whether the object is occluded
4	observation angle of the object
5-8	the size of the 2D bounding box
9-11	the size of the 3D bounding box
12-14	the position of the bounding box
15	spatial orientation of 3D bounding box
16	score

Output explanation



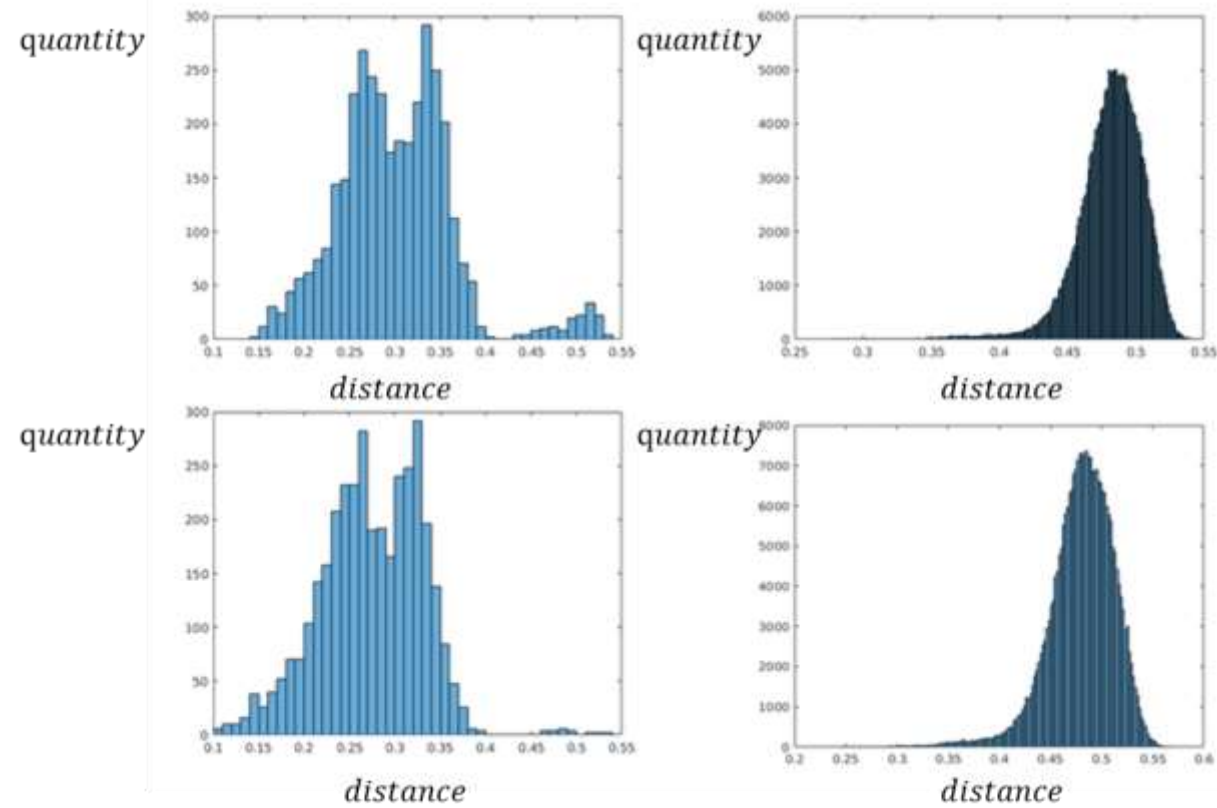
Iris representation

# LiDAR Iris



Height coding pattern

Scan Context

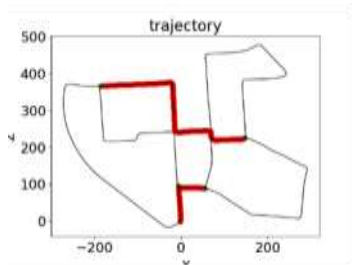


looped frames

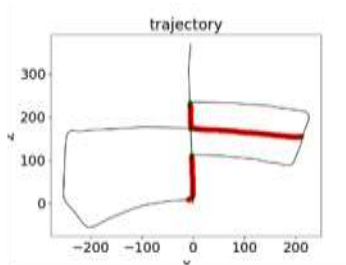
non-looped frames

# 04

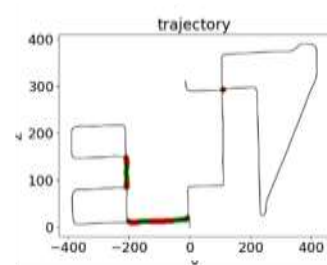
## Experiments



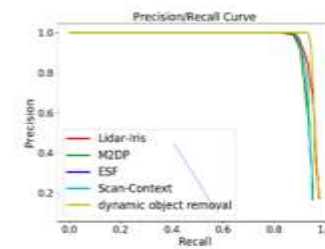
KITTI 00



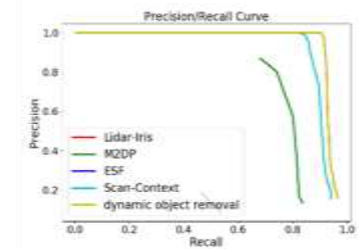
KITTI 05



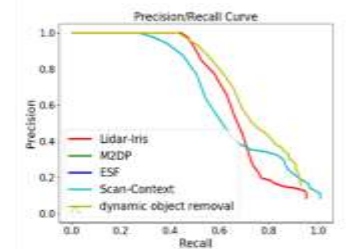
KITTI 08



KITTI 00



KITTI 05



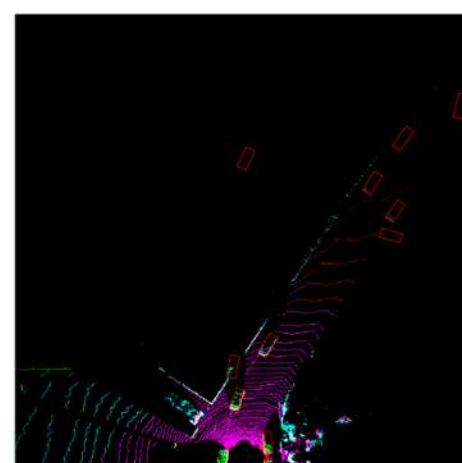
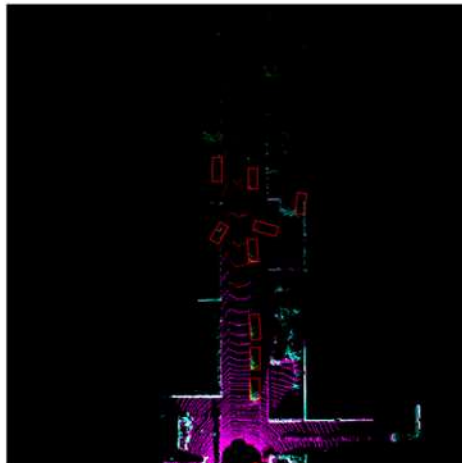
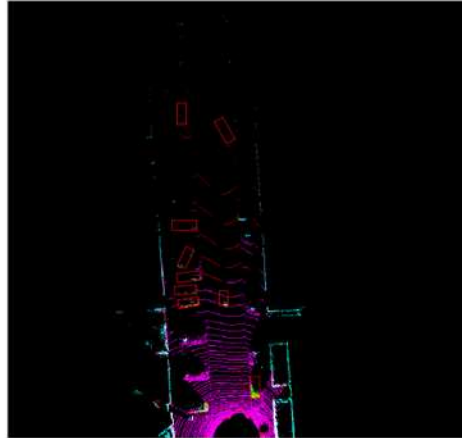
KITTI 08

Trajectory

Evaluation



# Dynamic Object Removal



THANKS!

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