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Occluded Point Clouds Classification via Point Clouds Completion

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Point Cloud

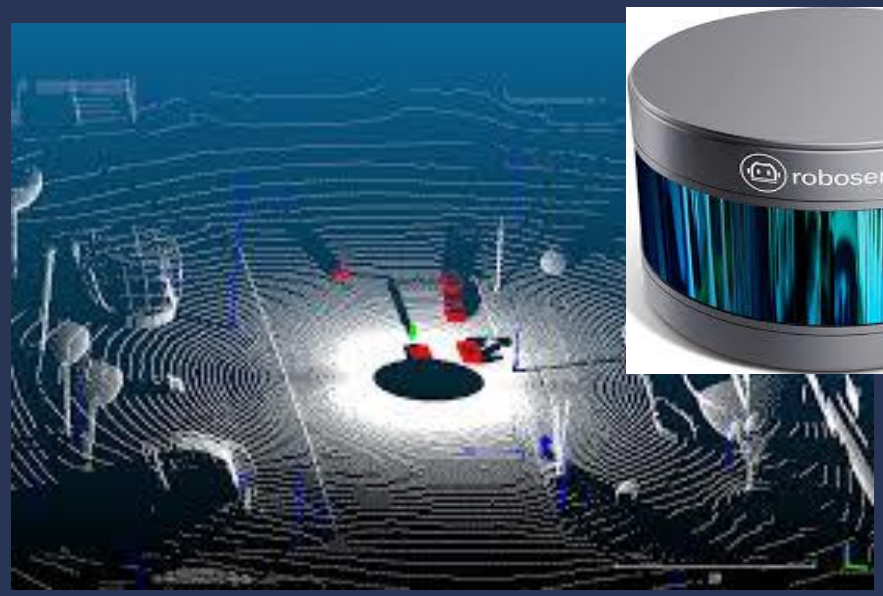
$\{ p_1, p_2, p_3, \ldots \}$

where p={x, y, z}

3D data

Point Cloud Sensor

LiDAR



RGB-D camera

Point Cloud

3D data

geometric shape scale

No need to
3D reconstruction

Point Cloud Applications

Autonomous driving

Robotics

Medical treatment

Computer vision

Segmentaion

Detection

Classification

SLAM

Point Cloud Computer Vision

Just Set of points $\{ p_1, p_2, p_3, \ldots \}$

where p={x, y, z}

UnStructed Unordered

~~CNN(structed)~~

~~RNN(ordered)~~

PointNet: consume raw point clouds

Permutataion Invariant

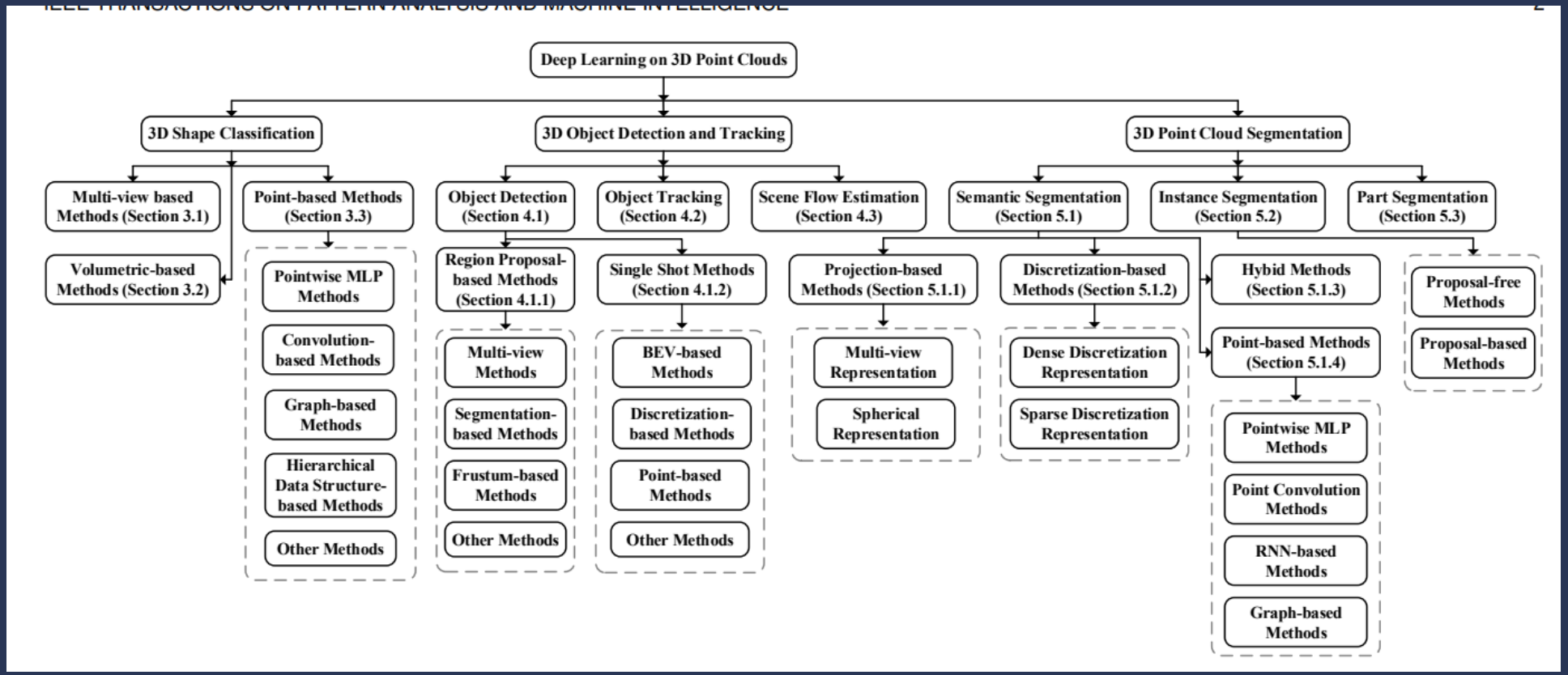
Symmetric Function

Point-wise mlp

$\{ p_1, p_2, p_3, \ldots \}$

where p={x, y, z}

PointNet-based



Are these reseaches practical ?

No, Why?

ShapeNet

ModelNet40

SharpNet

Prior researches are based on complete point clouds

Not practical in real life.

In real environment
using 3D scanning sensor

PointClouds are incomplete

Point Clouds are Incomplete

We can only obtain
a subset of point cloud

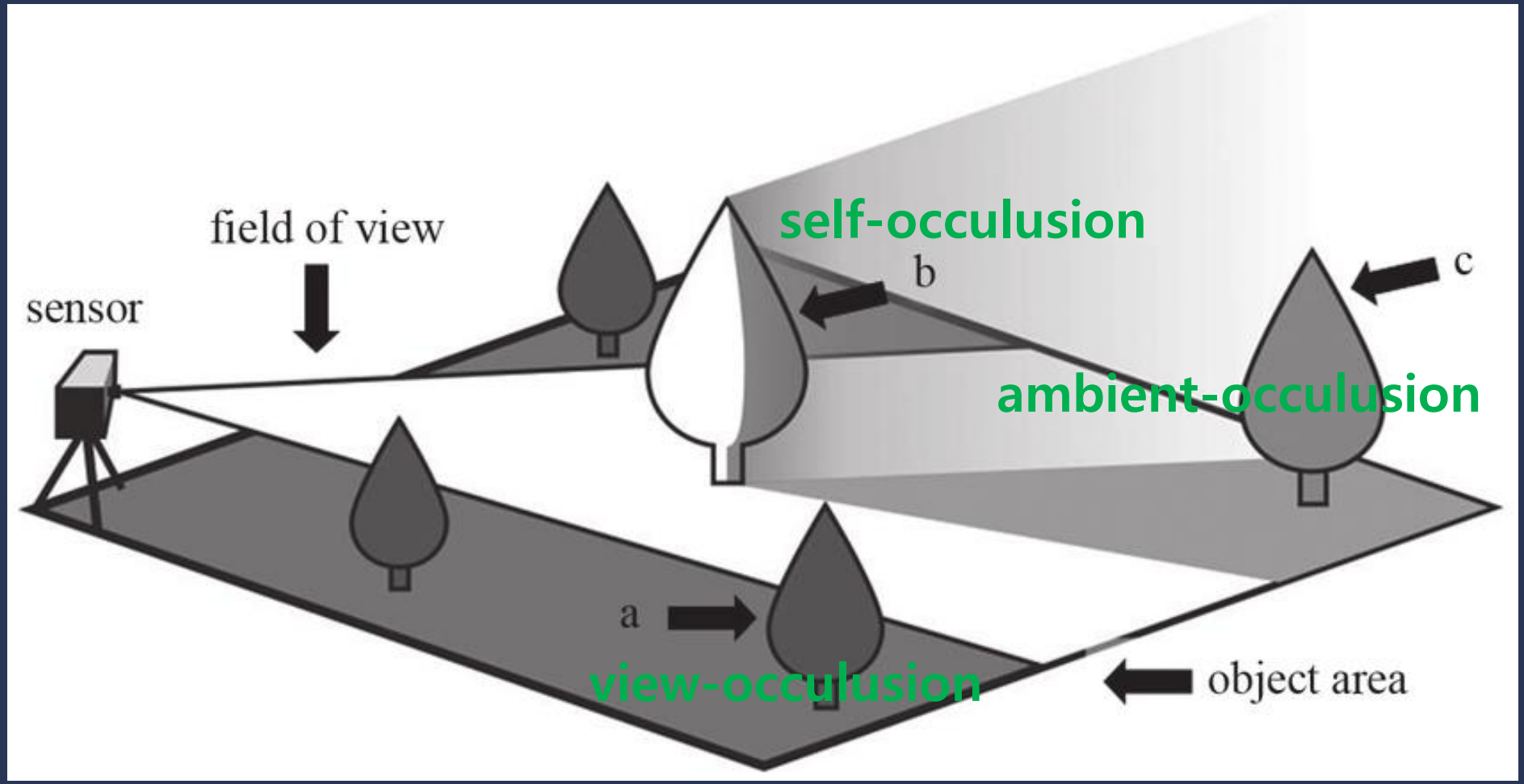
Point Clouds are incomplete!

occlusion

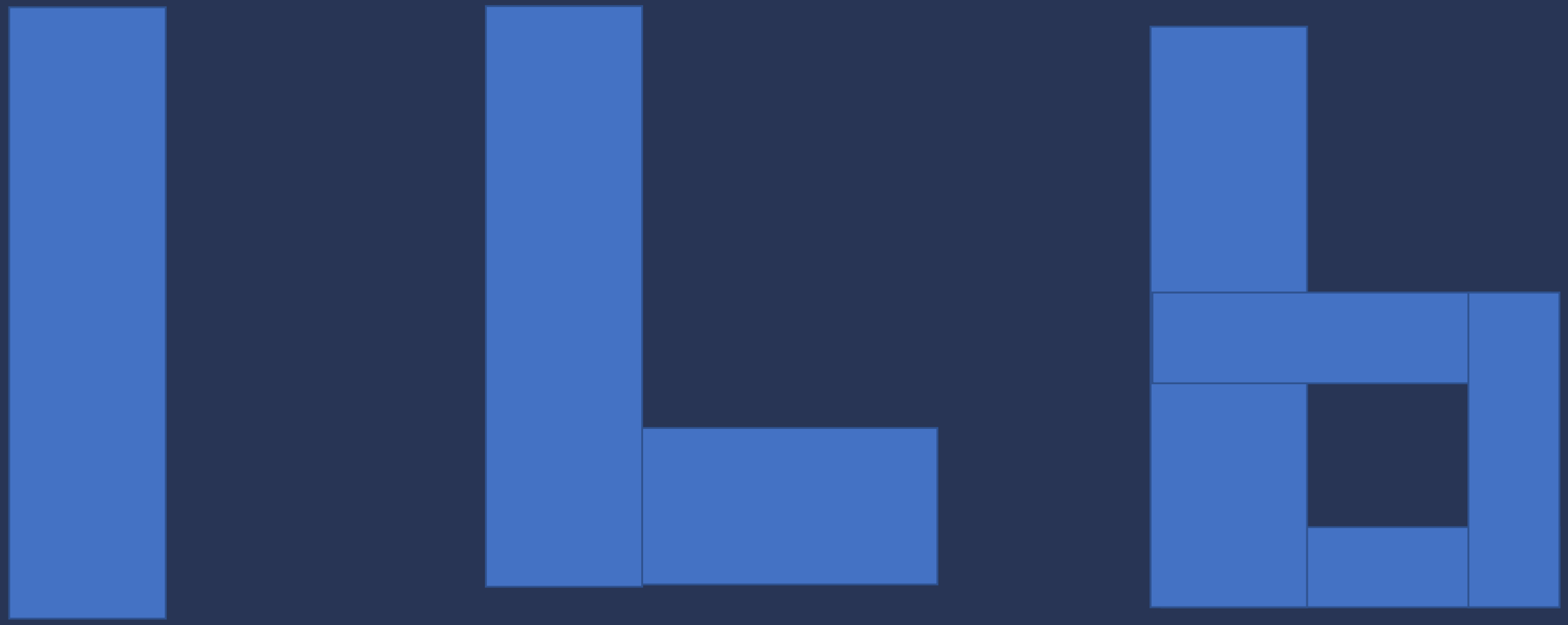
resolution

noise

Point Cloud Occlusion

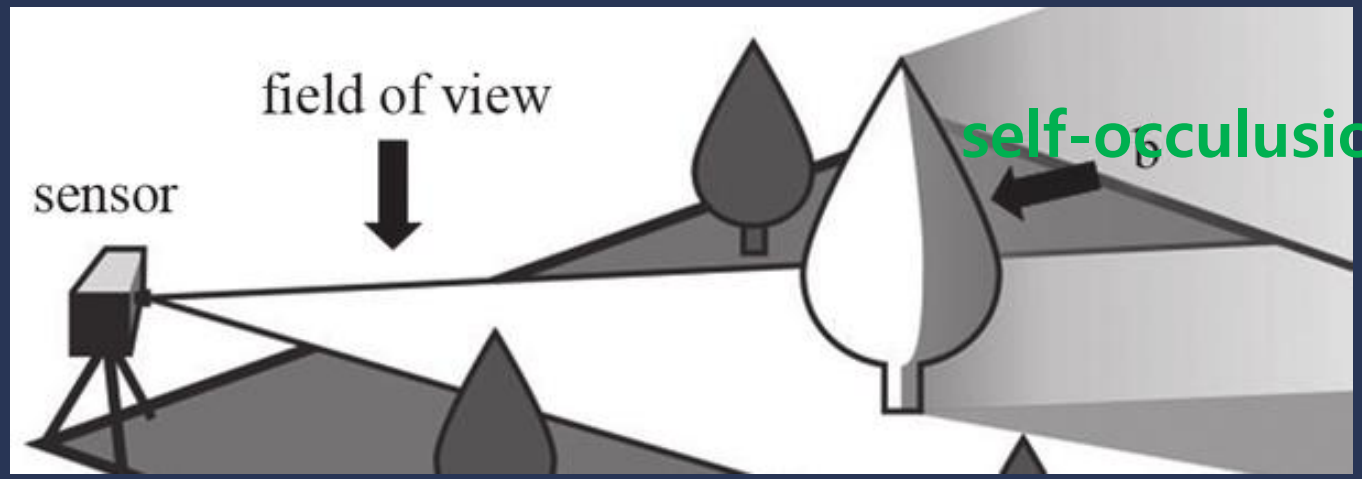


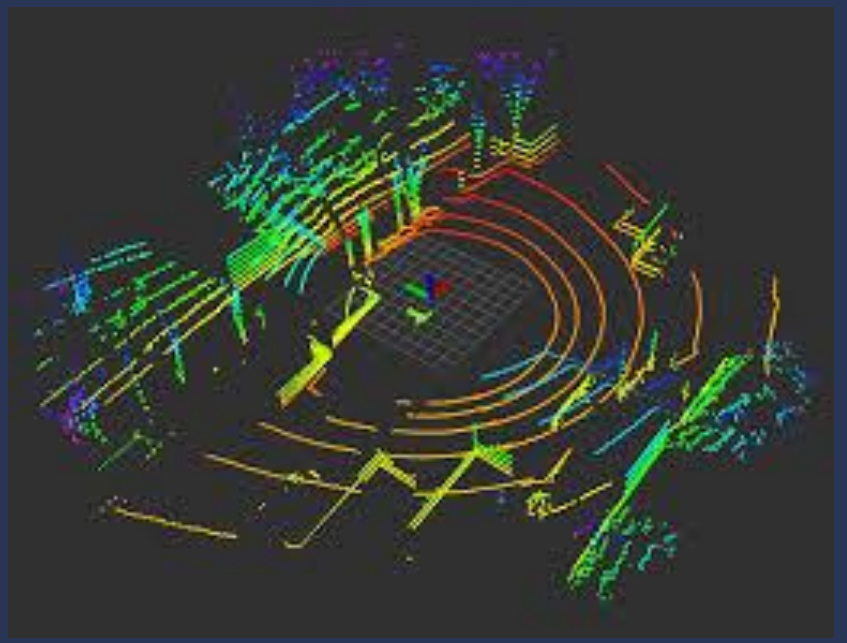
Point Cloud Occlusion



Point Cloud Occlusion

Self occlusion is inevitable

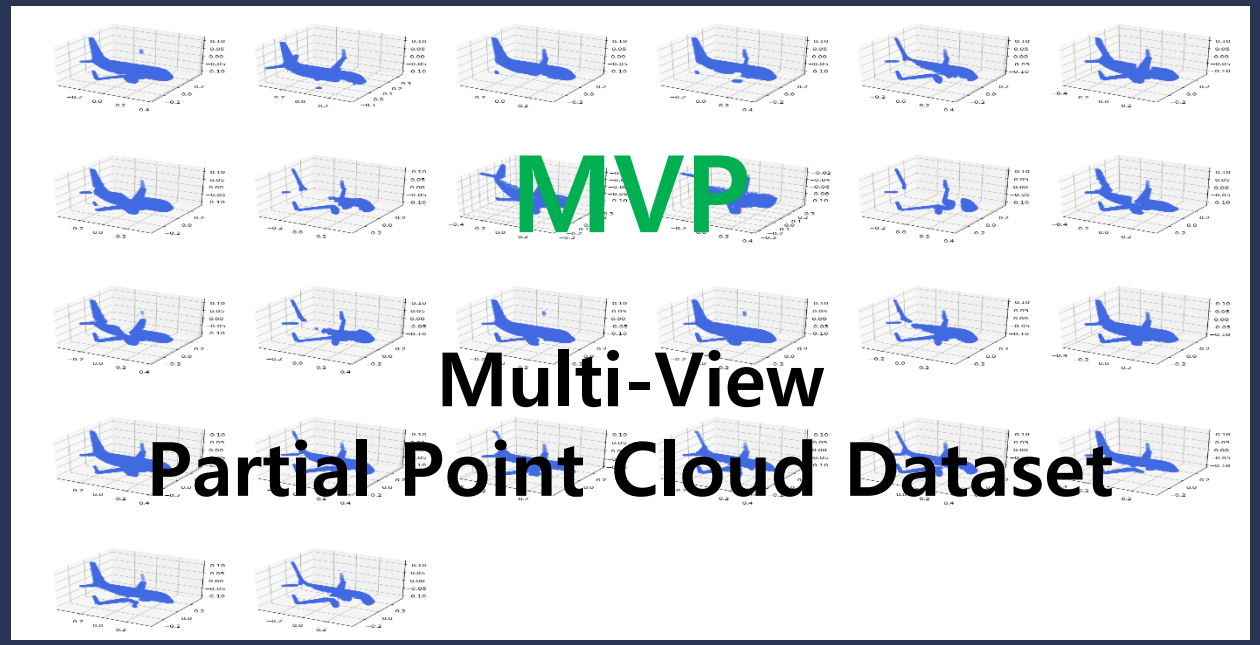




~~Complete 3D geometric shape~~

Incomplete Point Clouds Classification Experiment

Dataset



Classifier

PointNet

Experiment Result

Train	Test	Accuracy
complete 	 complete	90.06%
incomplete 	 incomplete	88.30%
complete 	 incomplete	68.11%

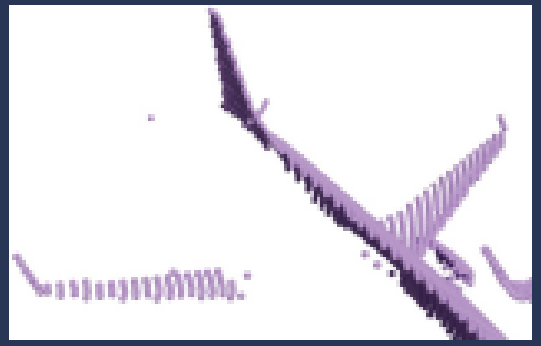
21.9%p ↓

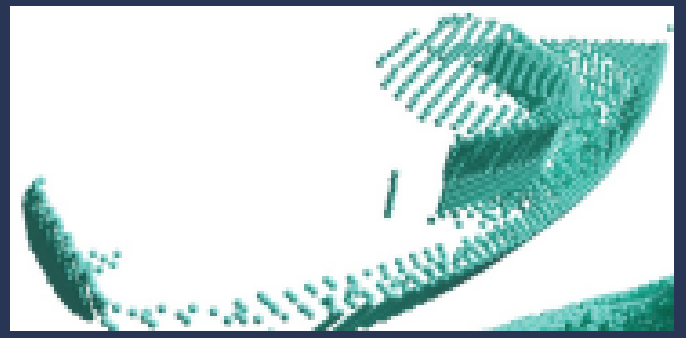
For Practical Application

For Real Enviornments

Algorithms should be robust to :

Incomplete(=occluded) point clouds

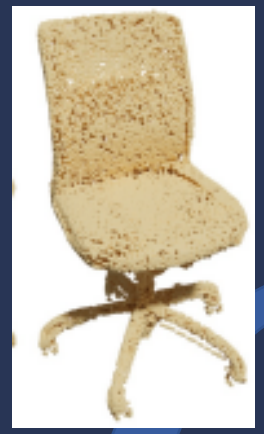




Occluded Point Clouds Classification via Point Clous Completion

Completion = Generation

Concept: 2-Step



Complete
Point Cloud

1. Generation

incomplete
Point Cloud

2. Classification

It's a chair!

Incomplete Point Clouds Classification Experiments

Generator & Classifier

Generator

PCN
(Point Completion Network)

AutoEncoder Based

Classifier

Pretrained PointNet

with complete point clouds

Incomplete Point Clouds Classification Experiments

No generation, Only Classfication

pre-trained Classifier

with complete point clouds

It's a chair

Accuracy 68.11%

Incomplete Point Clouds Classification Experiments

Generation to Classfication

Incomplete
Point Cloud

1.Generation
AutoEncoder Based

complete
Point Cloud

2. Classification
pre-trained Classifier
with complete pcds

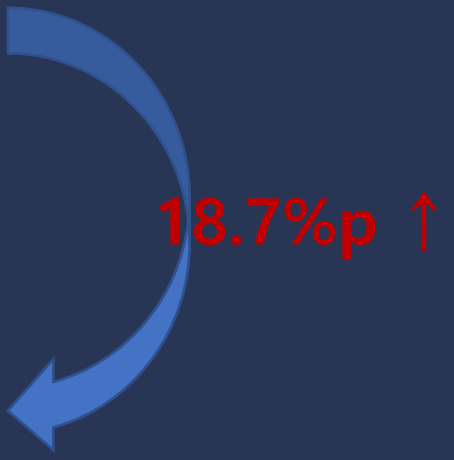
It's a chair

Accuracy

86.82%

Incomplete Point Clouds Classification Experiment Results

Method	Accuracy
Only Classfier	68.11%
Generator & Classfier	86.82%



Thank you

Q: Why not train on incomplete pcds

Train	Test	Accuracy
 complete	 complete	90.06%
		1.76%p ↓
 incomplete	 incomplete	88.30%
		21.9%p ↓
 complete	 incomplete	68.11%

Q: Why not train on incomplete pcds

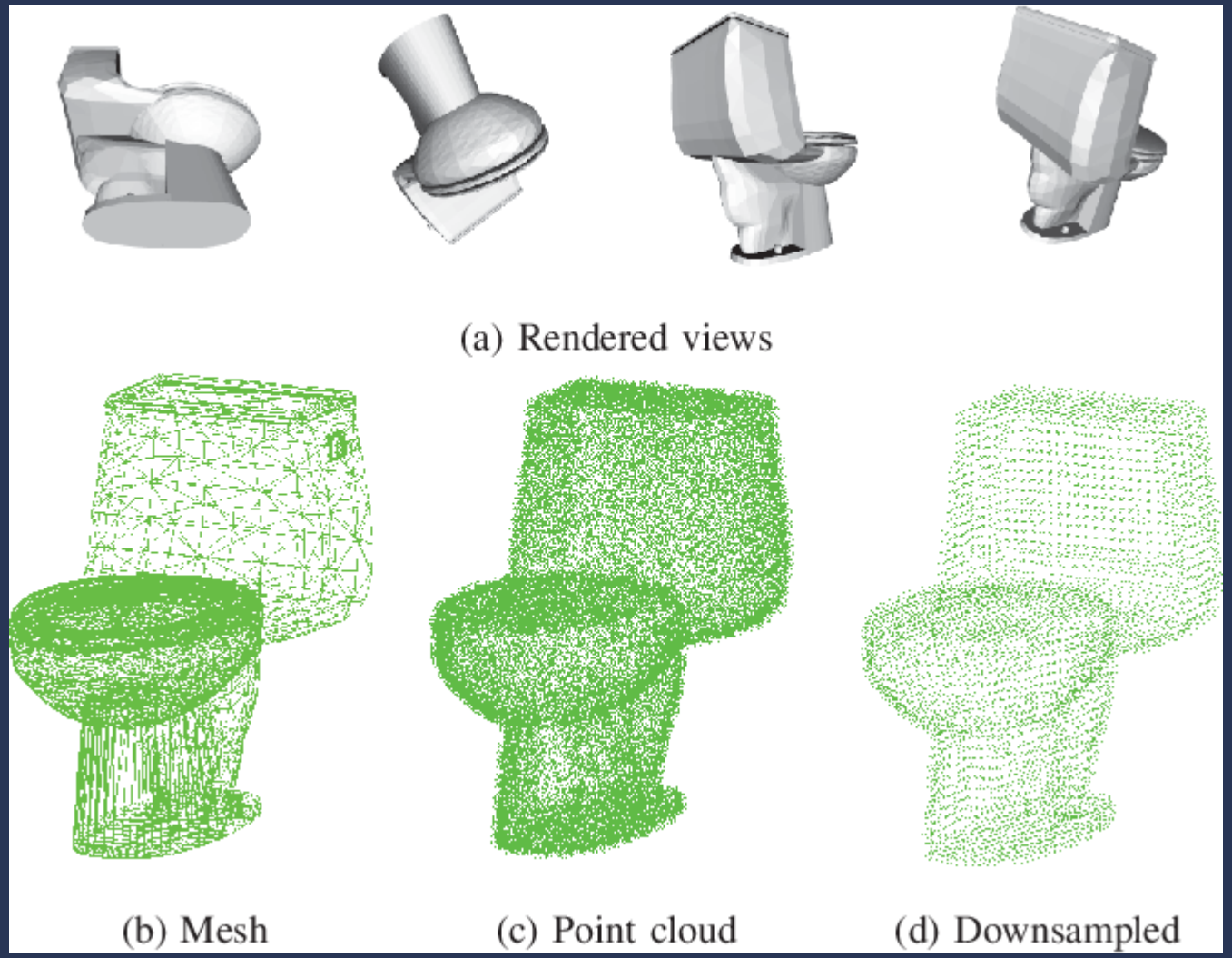
A1. Incomplete point clouds dataset is Hard to obtain.

Expensive sensor (Lidar)

Q: Why not train on incomplete pcds

3D CAD

Point Clouds



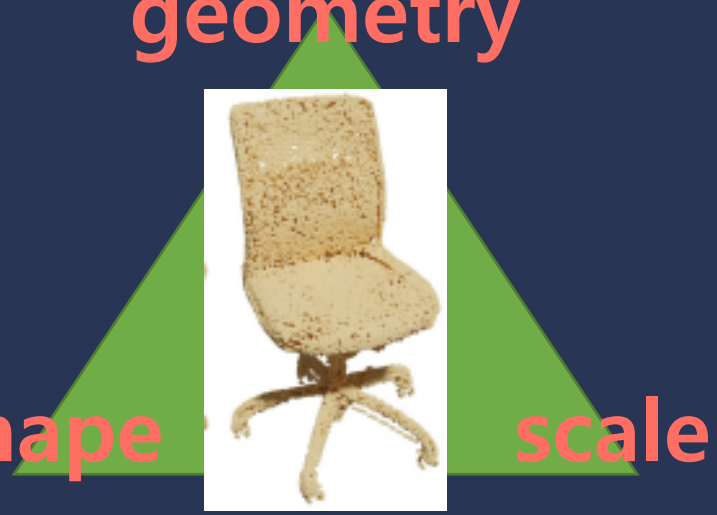
Q: Why not train on incomplete pcds

A2. Information Loss problem

complete

incomplete

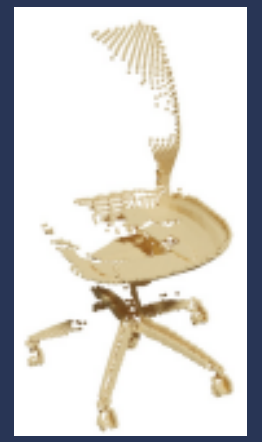
geometry



shape

scale

No need to
3D reconstruction



Incomplete
3D information

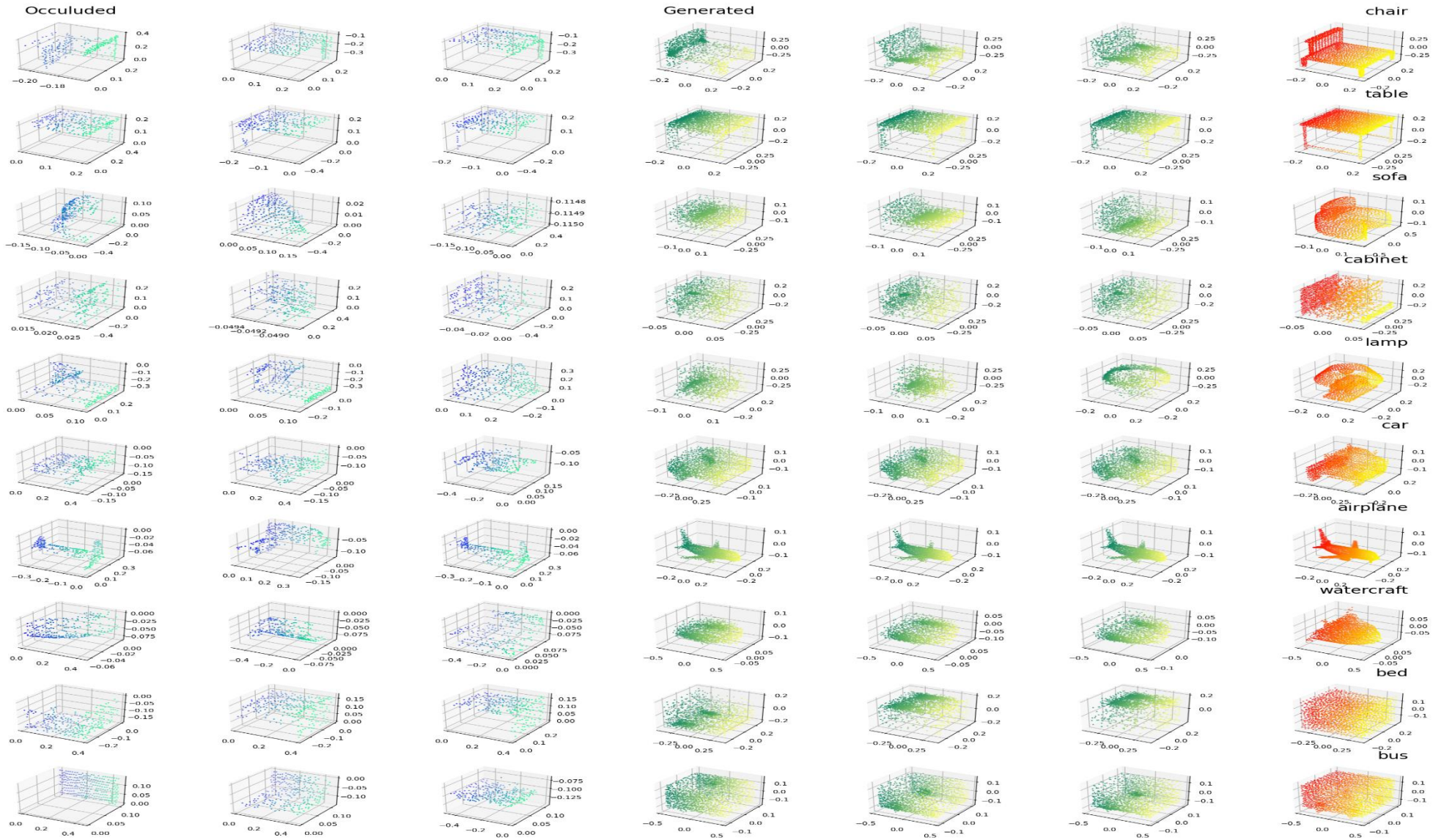
Q: Why not train on incomplete pcds

Incomplete point clouds dataset is Hard to obtain.

not practical

Information Loss problem

not optimal


Occluded
Generated
chair
table
sofa
cabinet
lamp
car
airplane
watercraft
bed
bus