Vehicle Classification from Profile Measures

Marco Patanè – Andrea Fusiello
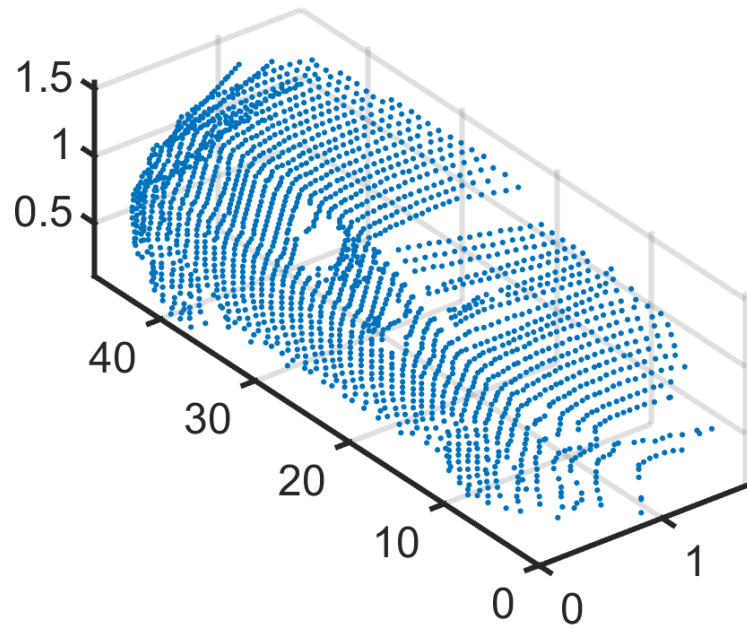
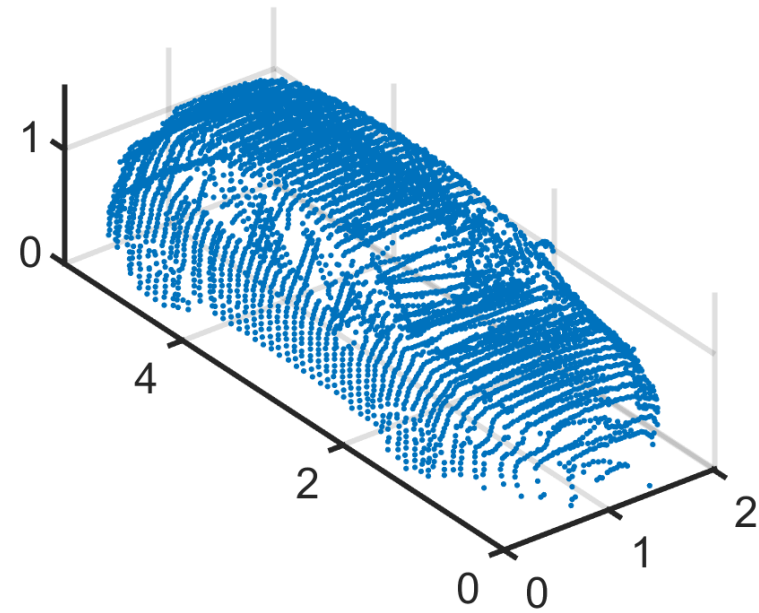Università degli studi di Udine

Vehicle Classification Problem

Goal: Classify vehicles from point clouds in two configurations

Non-metric configuration

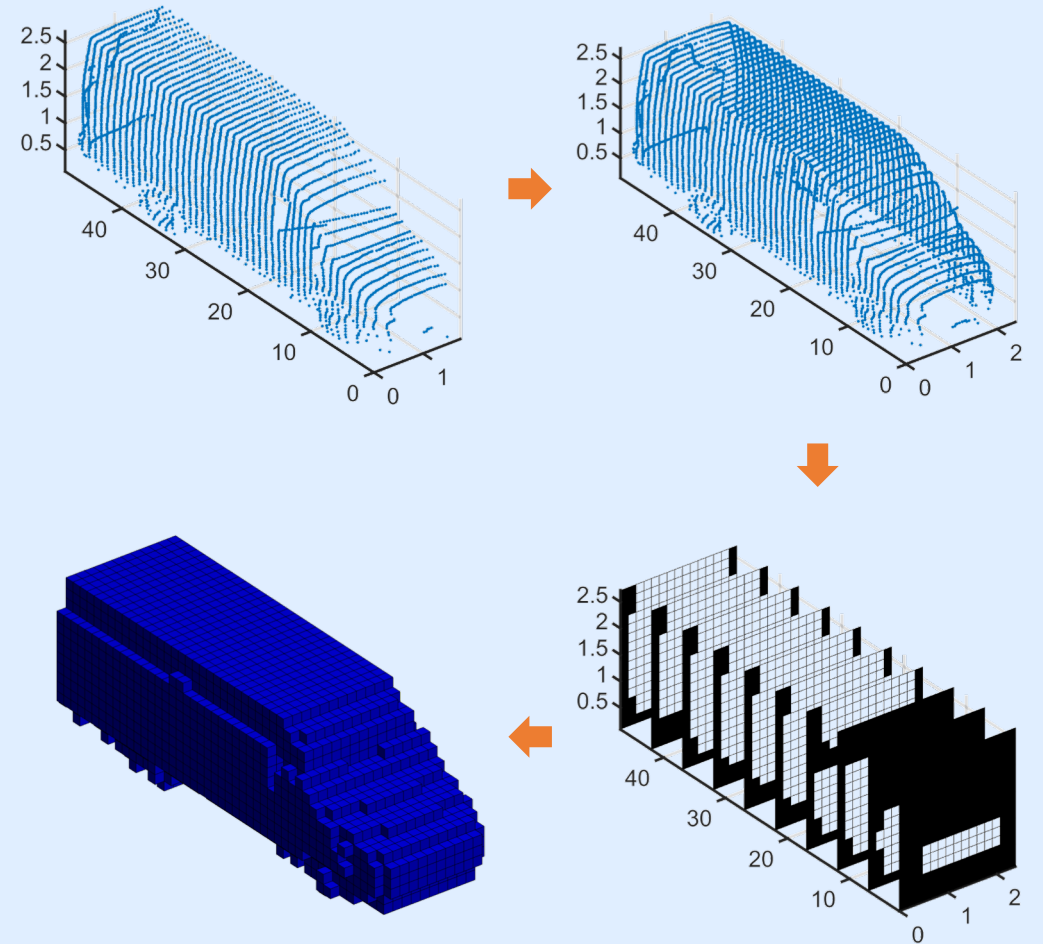Metric configuration

State of the art: VoxNet

CNN with 3-dimensional convolutional layers

Advantages

- Extraction of rich (shape) features
- Works in both configurations

Disadvantages

- Lack of metric information
- Low voxel resolution (16×48×16)
- High network complexity

Voxelization

State of the art: VoxNet architecture
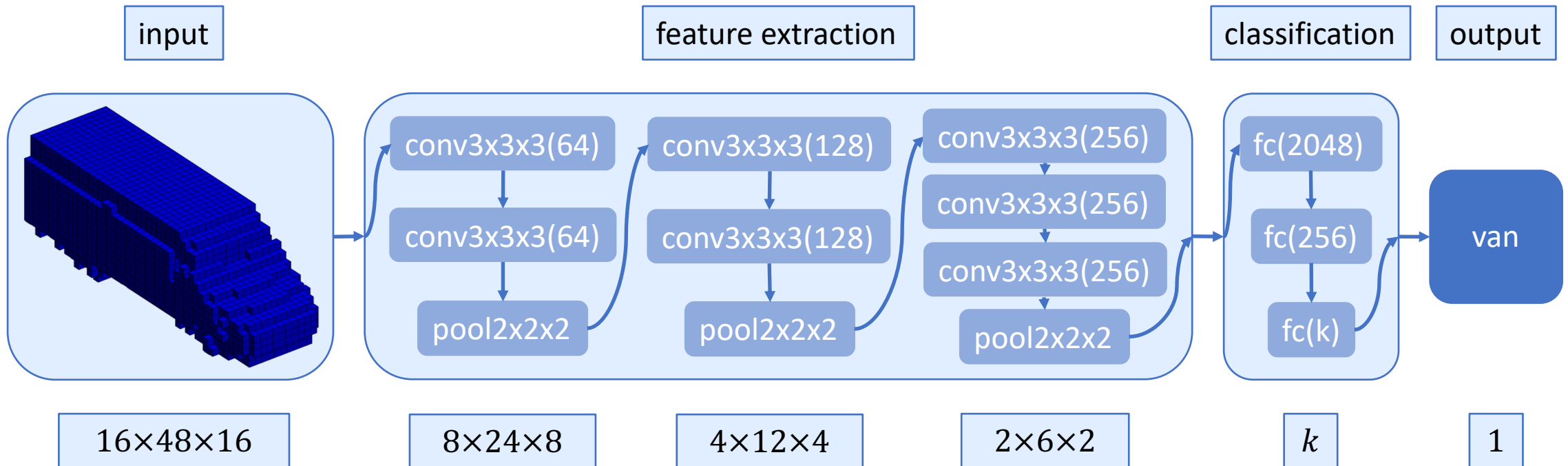
State of the art: PointNet

CNN with *pointwise* convolutions

Advantages

- Extraction of metric features

- No resolution problem

- Low network complexity

Disadvantages

- Works in metric configuration only

- Can't extract neighbourhood information well

Input:

$$n \times 3$$

which is unordered and
with variable length n

State of the art: PointNet architecture
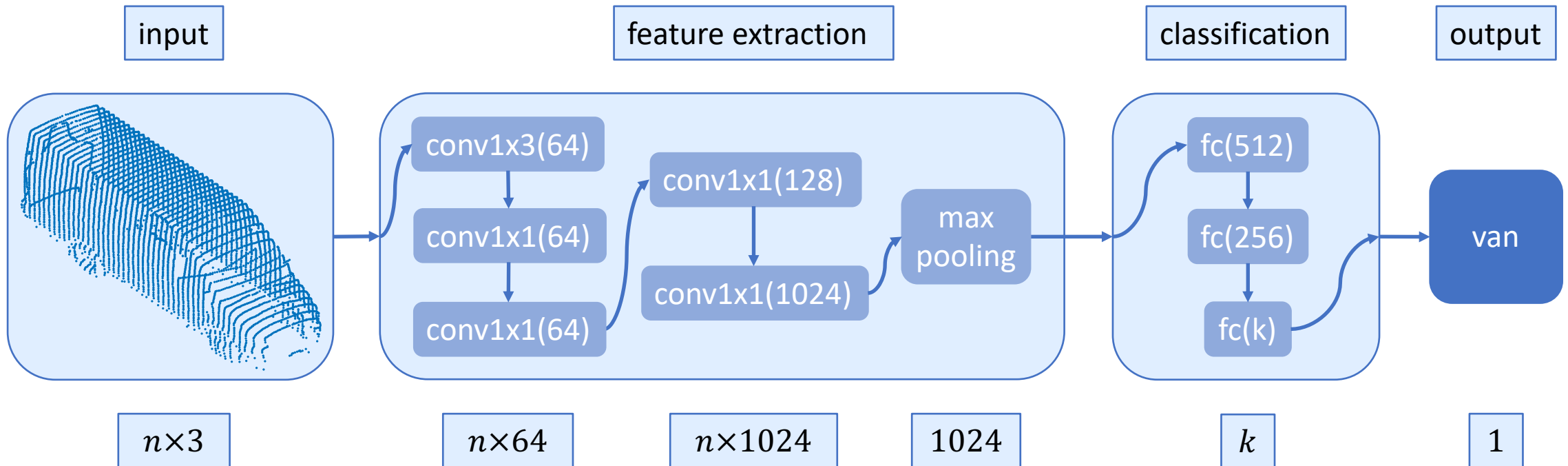
Our proposal

A CNN which is able to extract metric information from x and z coordinates, and non-metric one over y axis

⬇

The input is modified from point cloud to structured point cloud, reordering it in a tensor of shape (number of slices) x (number of points per slice) x 2

$$n \times 3 \longrightarrow s \times m \times 2$$

where n is the number of points, s is the number of slices, $m = \max\limits_{i=1,\dots,s} n_i$, and n_i is the number of points in the i-th slice.

Our proposal: SliceNet
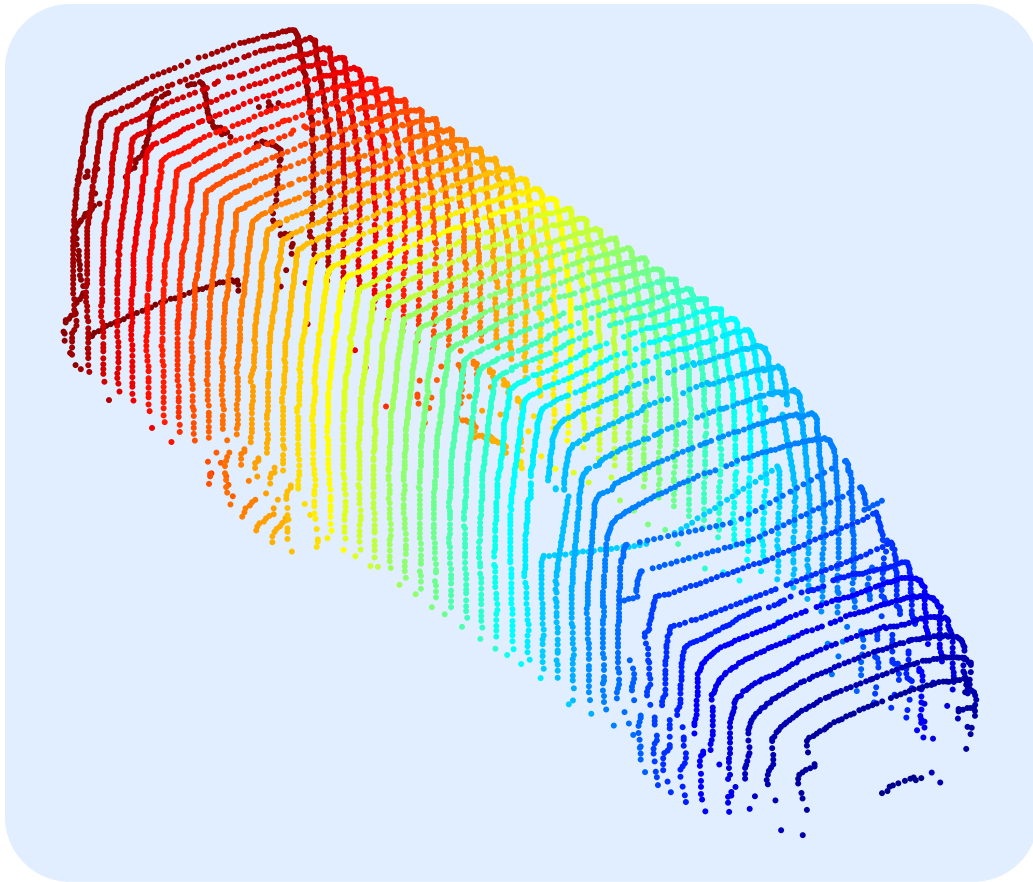
Combination of PointNet and VoxNet

Advantages

- Extraction of metric features over x and z axis

- Extraction of neighbour information over y axis

- Low network complexity

- Works in both configurations

Disadvantages

- In metric configuration y coordinate is not exploited

Our proposal: SliceNet architecture
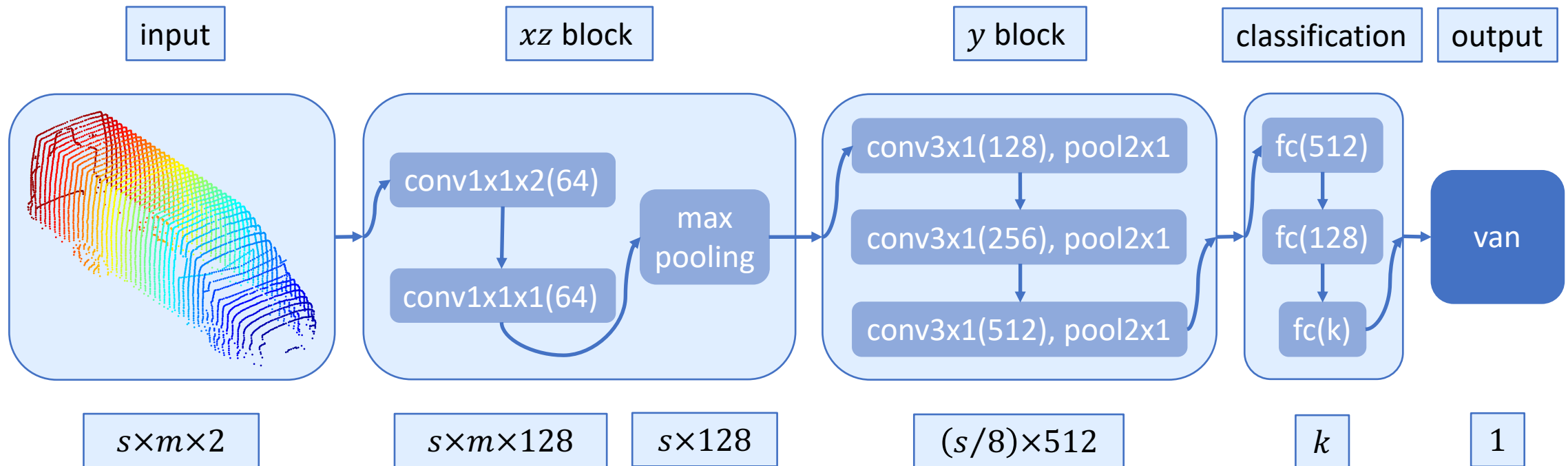
Our proposal: SliceNet GAP architecture
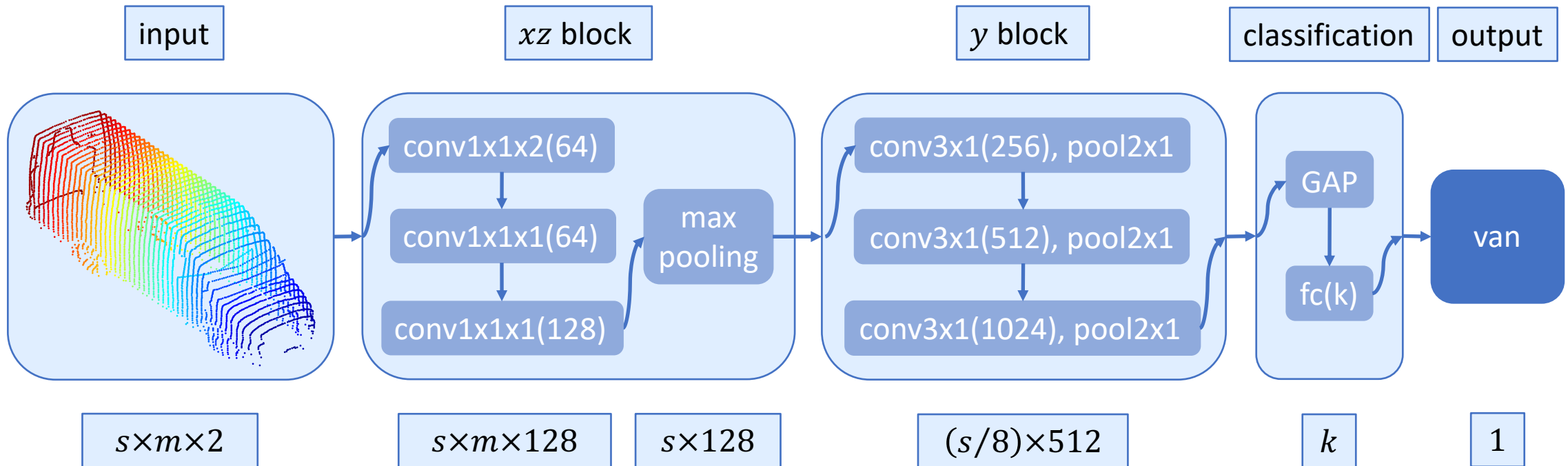
Experiments: Datasets

	# samples	# classes (k)
Non-metric	~6900	18
Metric	~2500	8
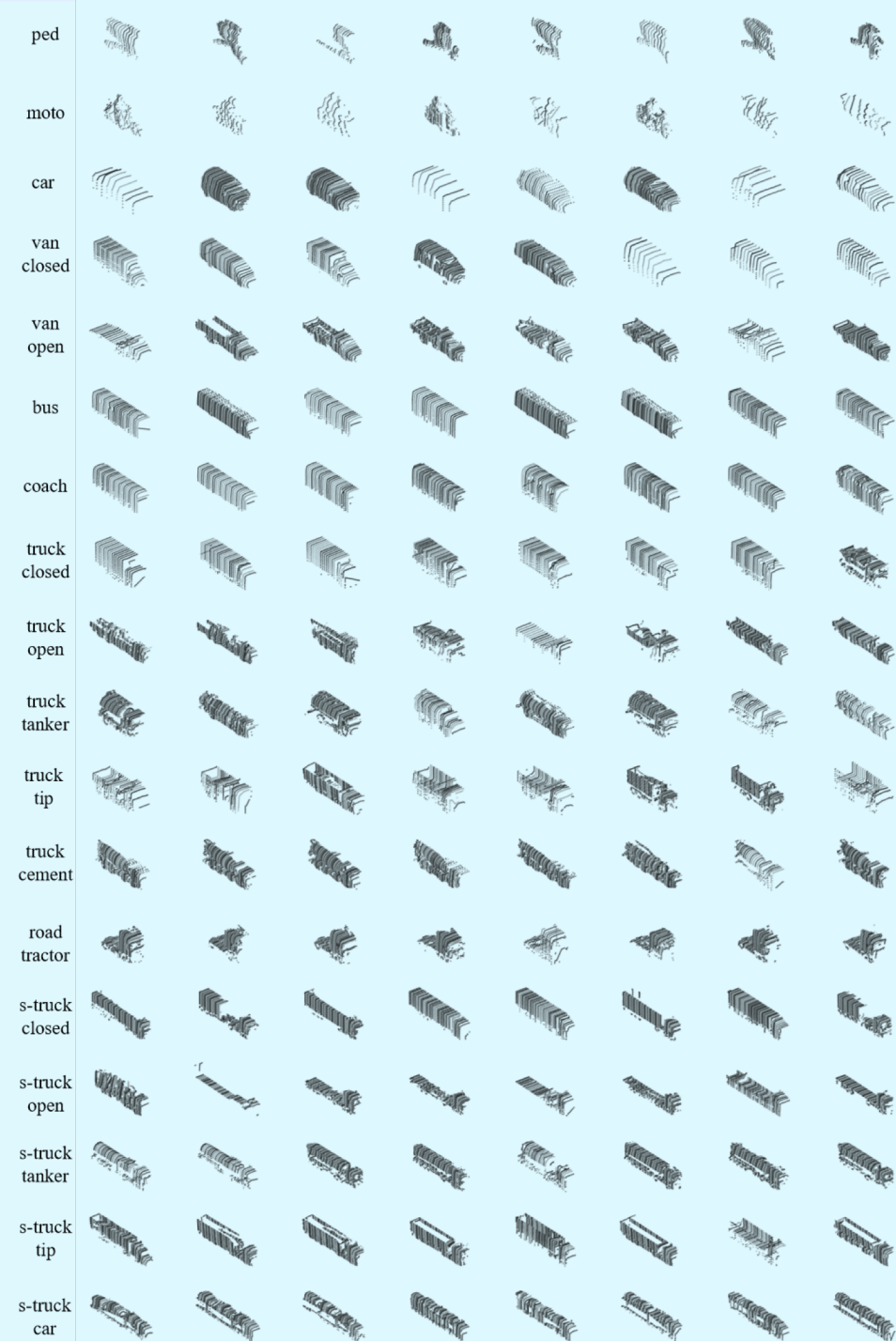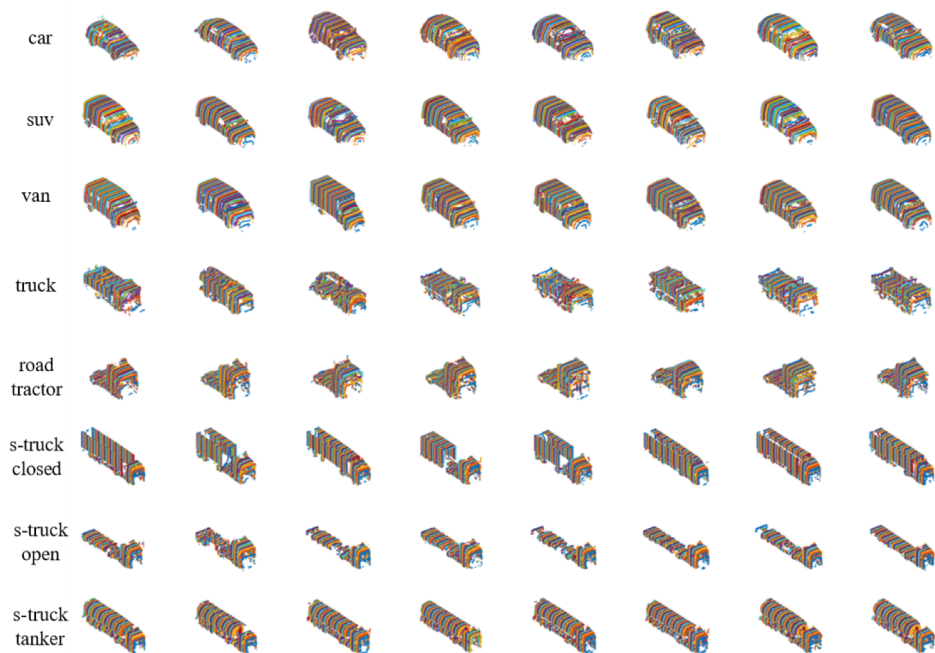
Experiments: Results
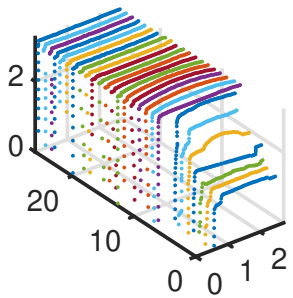
(a) Van, misclassified as truck.
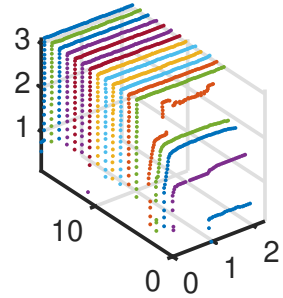
(b) Truck, misclassified as van.

(c) Bus, misclassified as coach.

(d) Coach, misclassified as bus.

	Accuracy	
	Non-metric	Metric
VoxNet	96.6	99.3
PointNet	96.7	99.4
SliceNet	97.2	99.4
SliceNet GAP	97.1	99.2

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29,,300,0,0.0,300,van,0,0,0,1000,0,0,0,0,0,0,0,0,0,0,0,0
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57,,300,0,0.0,300,van,0,0,0,1000,0,0,0,0,0,0,0,0,0,0,0,0
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64,,220,0,0.0,200,car,0,0,1000,0,0,0,0,0,0,0,0,0,0,0,0,0
65,,100,0,0.0,100,motorbike,0,1000,0,0,0,0,0,0,0,0,0,0,0,0,0,0
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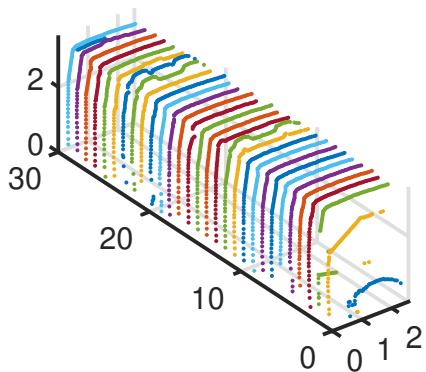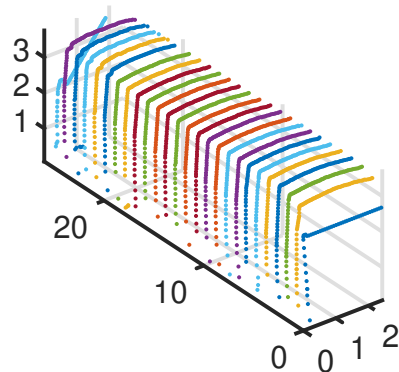
Thank you for your attention!