First experiments of deep learning on LiDAR point clouds for classification of urban objects

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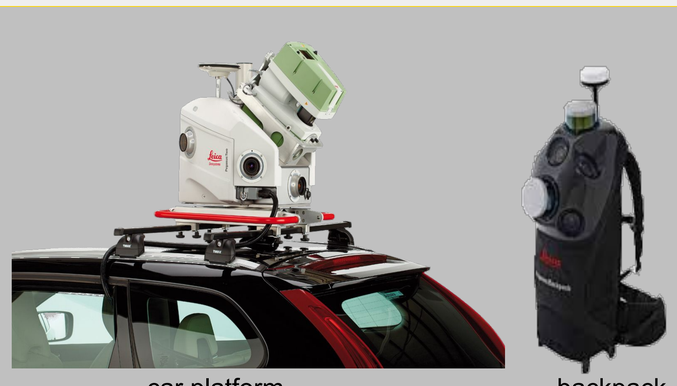
INTRODUCTION

- Urban environment monitoring and management [5].
- Dynamic LiDAR acquisition to scan entire scene.
- Urban object detection and recognition.
- Projecting all collected data in GIS.
- Deep-learning [4] methodology for shape classification.



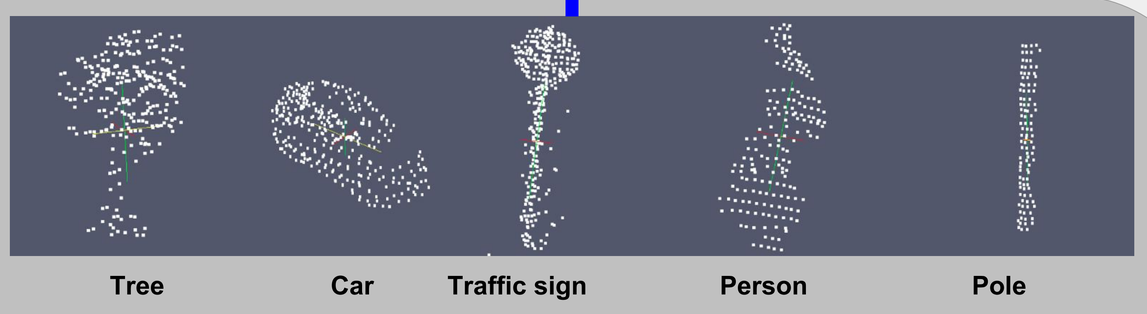
Mobile LiDAR devices : car platform backpack

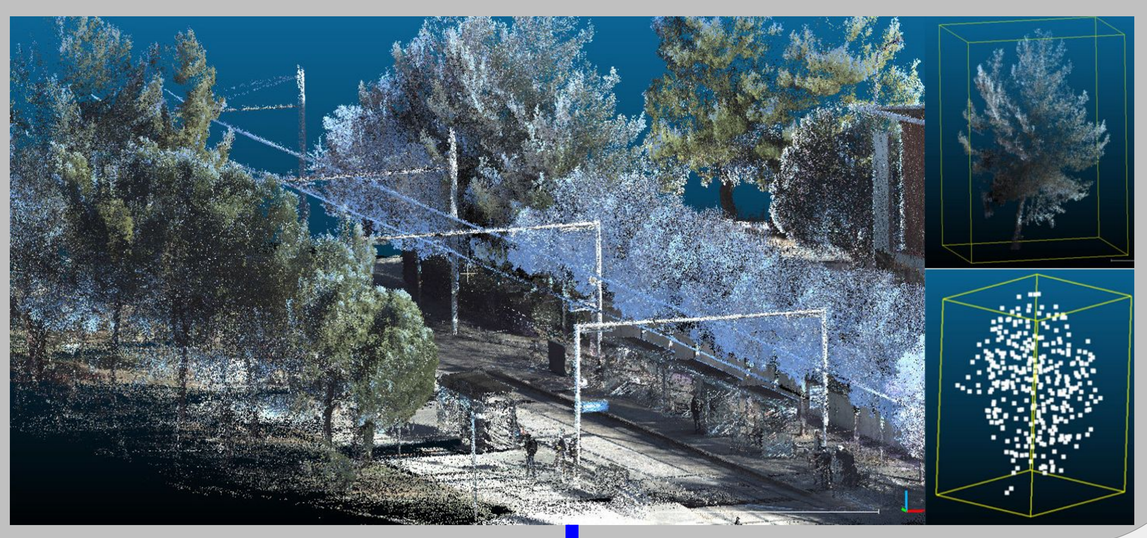
3D URBAN OBJECT DATASETS

- 1 urban object = 1 point cloud
- Subsampling the point clouds to 512 points

- From public datasets: (727 objects)
  - Sydney urban dataset:
    http://www-personal.acfr.usyd.edu.au/a.quadros/objects4.html
  - Kevin Lai dataset:
    https://sites.google.com/site/kevinlai726/datasets
  - Paris rue Madame dataset:
    http://cmm.ensmp.fr/~serna/rueMadameDataset.html

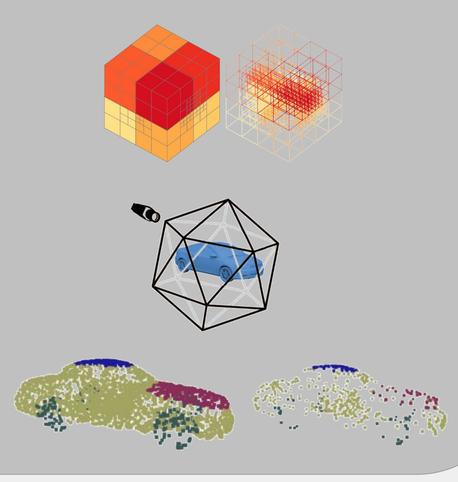
- Our dynamic LiDAR acquisition:
  - 200 meters back and forth with Leica Pegasus backpack
  - 27 millions points (x, y, z) + RGB
  - 174 urban objects isolated manually





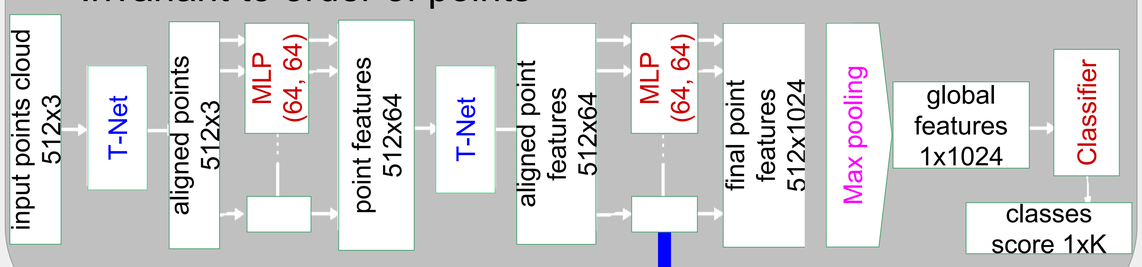
DEEP-LEARNING FOR 3D POINT CLOUD CLASSIFICATION

- Voxelizing the clouds [3]
- Using multi-views [2]
- Learning directly on point [1]

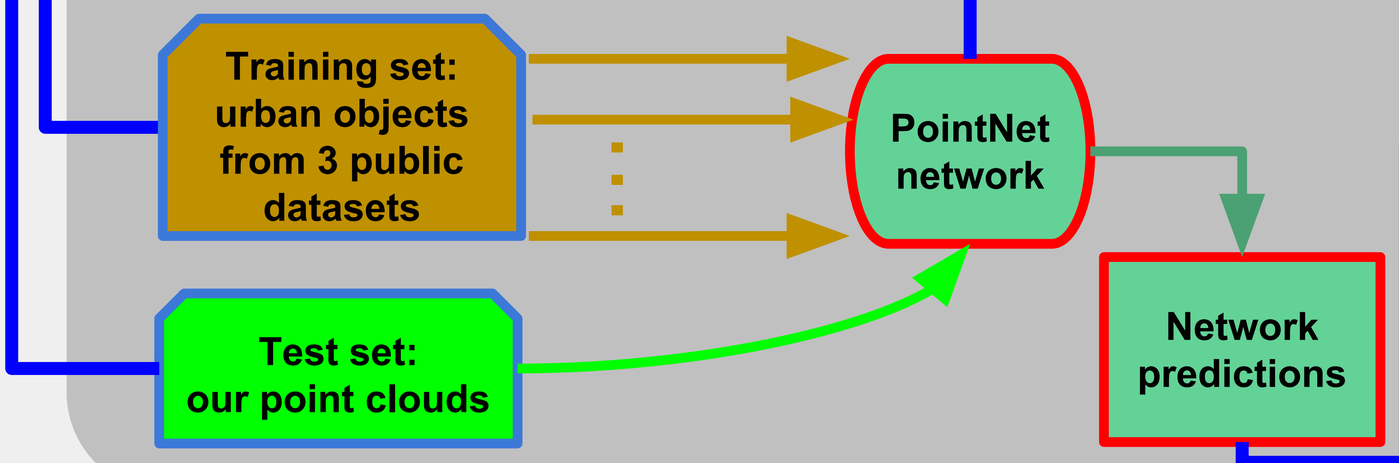


SELECTED METHOD: POINT-NET [1]

- Points (x, y, z) are directly processed
- Coordinate frame normalized with T-Net
- Invariant to order of points



CLASSIFICATION EXPERIMENTS



Classification	Ground truth	tree (75)	car (39)	traffic sign/light (8)	pole (23)	person (15)
	"tree"	69	2	0	8	0
	"car"	1	33	0	0	0
	"traffic sign/light"	4	0	4	12	2
	"pole"	0	0	3	1	0
	"person"	1	0	1	0	12
	"building"	0	0	0	2	0
	"noise"	0	4	0	0	1
	F measure	0.896	0.904	0.267	0.074	0.828

CONCLUSION

- Encouraging results for classification
- Class confusion “traffic sign”/”pole”
- Limited size of the dataset

FUTURE WORK

- Acquisitions of new datasets
- Object localization in a scene
- 3D+t analysis of scene variation

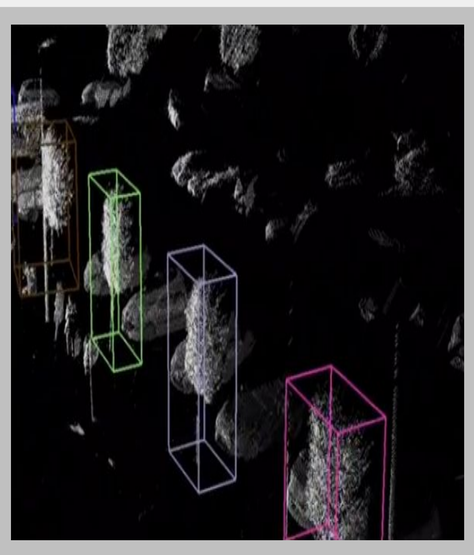


image from : Geo-Plus VisionLidar

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