TU WIEN Informatics

Diplomartbeitspräsentation der Fakultät für Informatik

Classification Of Urban Point Clouds Using 3D CNNs
In Combination With Reconstruction Of Sidewalks

Masterstudium:
Visual Computing

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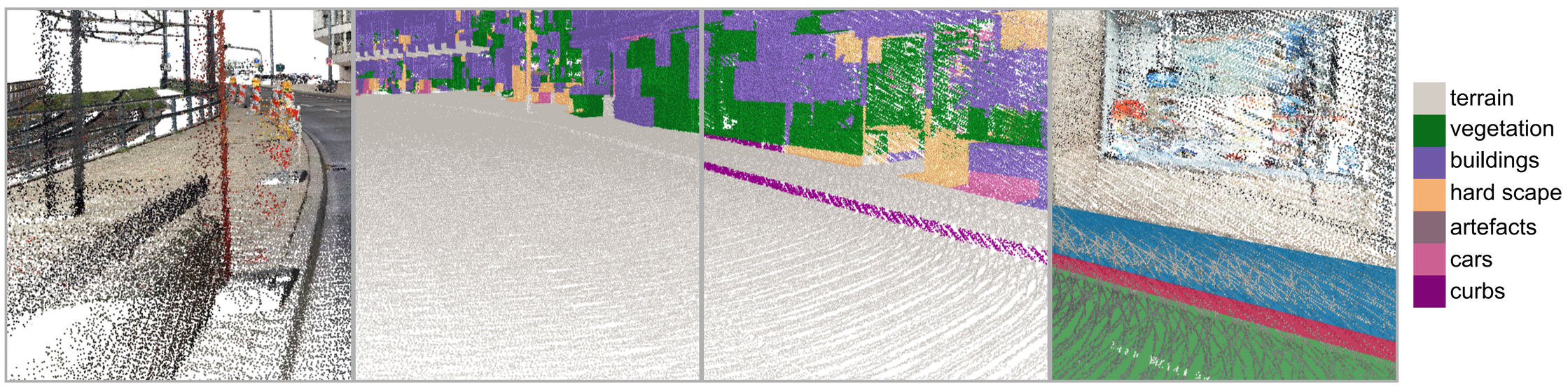
Motivation

- LiDAR (laser scanning) data are very large, but often just a small part of the point cloud is of interest to solve a problem
- A semantic segmentation makes it possible to filter a point cloud smartly before applying algorithms
  - › Reducing points to process enormously & eliminating possible sources of errors
- A semantic segmentation of a point cloud can be used for various applications
  - › Reconstruction of curb, sidewalk & street geometry as a practical example of application

Method



Semantic Segmentation:

- Developed & trained 3D CNN
- Octree as base data structure
- Data samples = rasterized nodes + neighbours of certain level
- Trained on Semantic3d dataset[1]

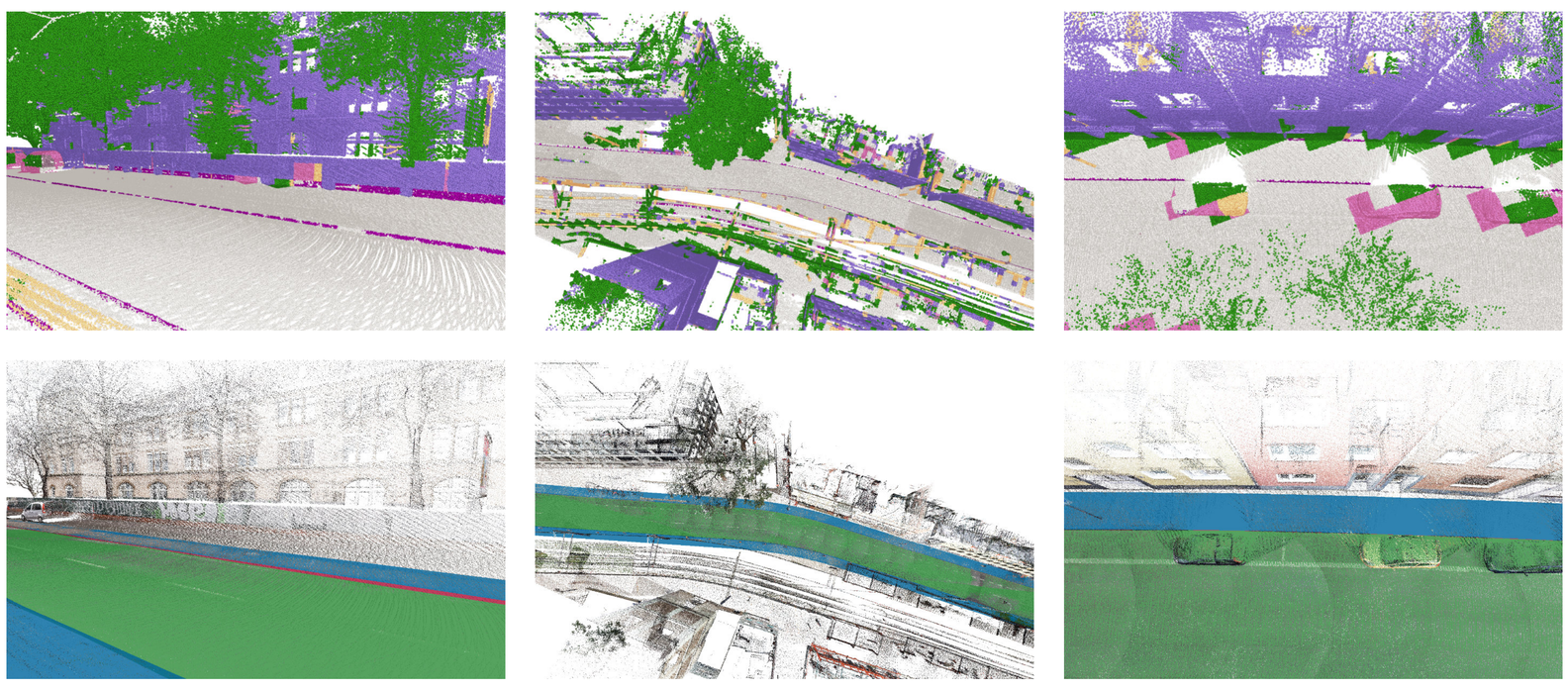
Detection of curb points:

- Point cloud features
  - › Height difference
  - › Height Std. Dev.
  - › Curvature
  - › Perpendicularity to street

Reconstruction of geometry:

- Filter false-positive curb points
  - › Density based clustering
  - › Approx. linearity & parallelism to the road
- Reconstruction of polyongs
  - › 2D fitting of course of the curb
  - › Upper & lower 3D curb edges
  - › Plane fitting for sidewalk

Results[2]



Segmentation accuracy on Semantic3d training set:

Used for training: 93.73%
Not used for training: 95.51%

Mean reconstruction error:

Curbs: ±1.8 cm
Street: ±3.3 cm
Sidewalk: ±2.3 cm

Conclusion and Further Work

- Successful proof-of-concept prototype
- Method is quite general
- Method showed a lot of potential
- Can be easy adapted to other applications

- Improving semantic segmentation
  - › Hierarchial classification
  - › Pointwise segmentation network
  - › Transfer learning to add "curb" class

- Improving reconstruction
  - › Enhance false-positive filtering
  - › Compute degree of fitting function
  - › Create geometry not parallel to the road

[1] Source: www.semantic3d.net

[2] Sources of dataset: CycloMedia Deutschland, LiDAR Point Cloud & Stadtentwässerungsbetriebe Köln, AöR

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