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

**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 polygons
  - 2D fitting of course of the curb
  - Upper & lower 3D curb edges
  - Plane fitting for sidewalk

Results

- **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
  - Hierarchical 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