UNIVERSITY OF TWENTE.

AUTOMATED EXTRACTION OF 3D BUILDING MODELS AND STREET FURNITURE FROM POINT CLOUDS

GEORGE VOSSELMAN

BIAO XIONG

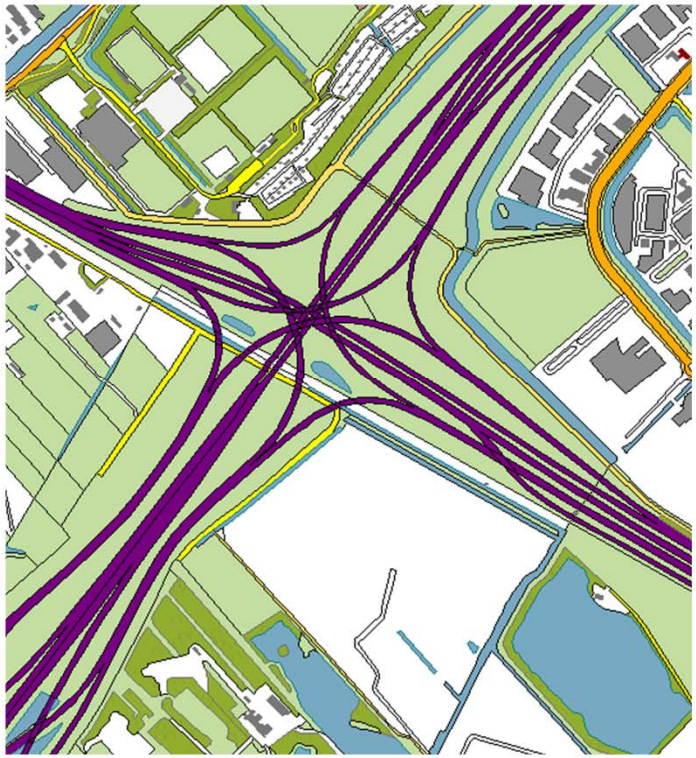
FASHUAI LI

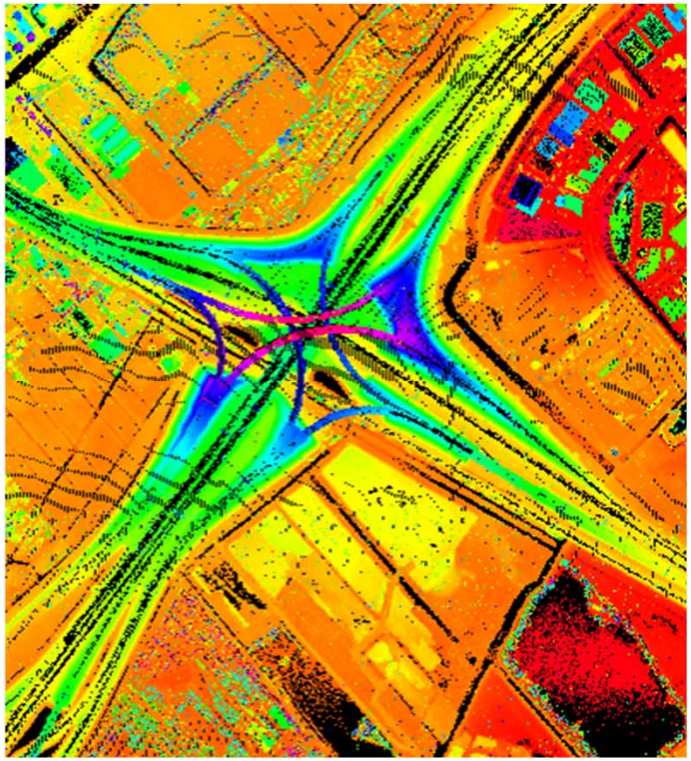
SANDER OUDE ELBERINK

ITC FACULTY OF GEO-INFORMATION SCIENCE AND EARTH OBSERVATION

3D TOP10NL - NATIONAL LANDSCAPE MODEL

Fusion of the national topographic database TOP10NL with the national elevation data AHN-2

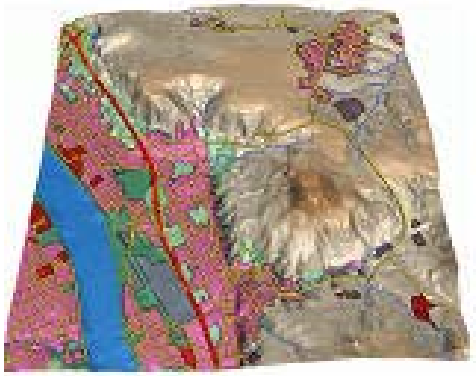




3D TOP10NL - VALKENBURG

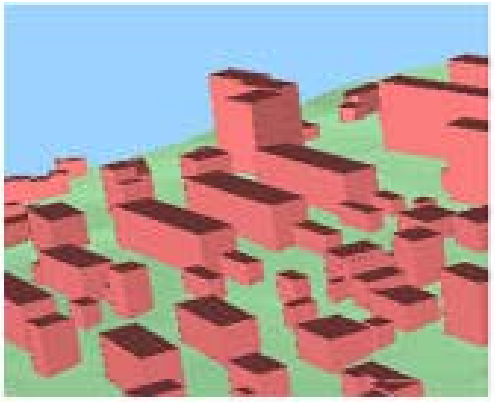
CITYGML - LEVELS OF DETAIL (LOD)

2.5D terrain



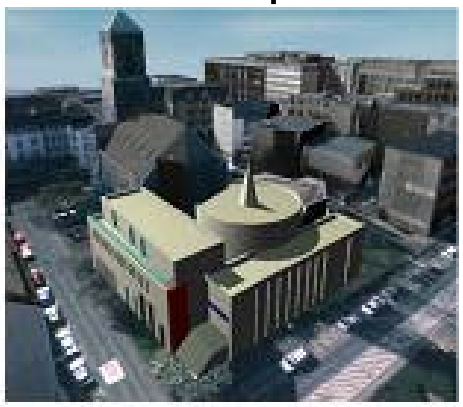
LoD0

flat roofs



LoD1

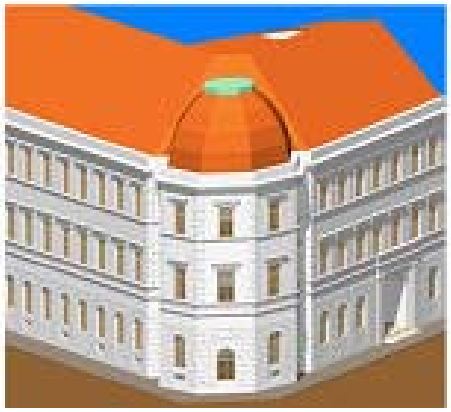
roof shapes



LoD2

LoD3

façade details



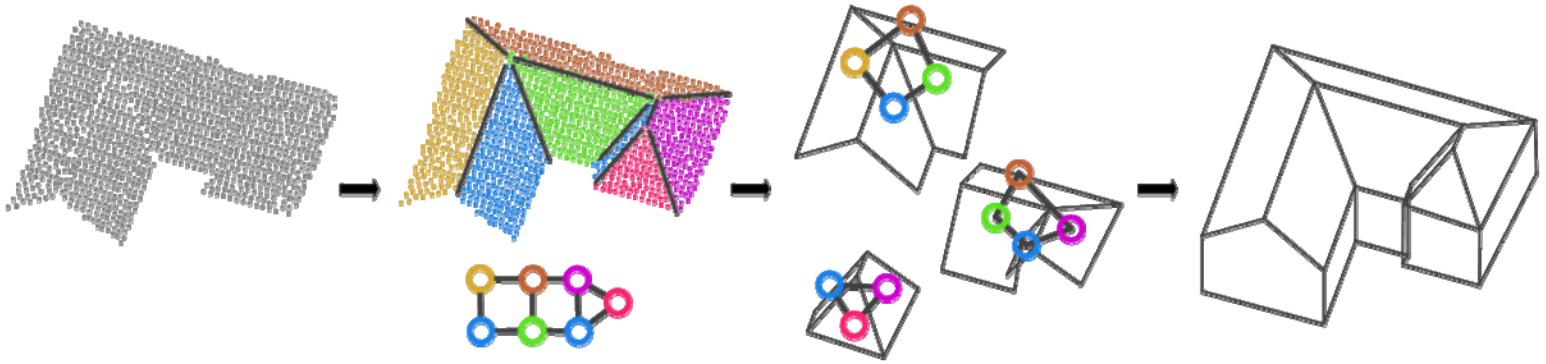
LoD4

indoor models

FEASIBILITY OF NATIONWIDE LOD2 BUILDING MODELLING

- Various approaches (data-driven, model-driven)
- Roof topology graphs and target graph libraries

Point cloud Segmentation Decomposition Building model



Roof topology graph Target graphs

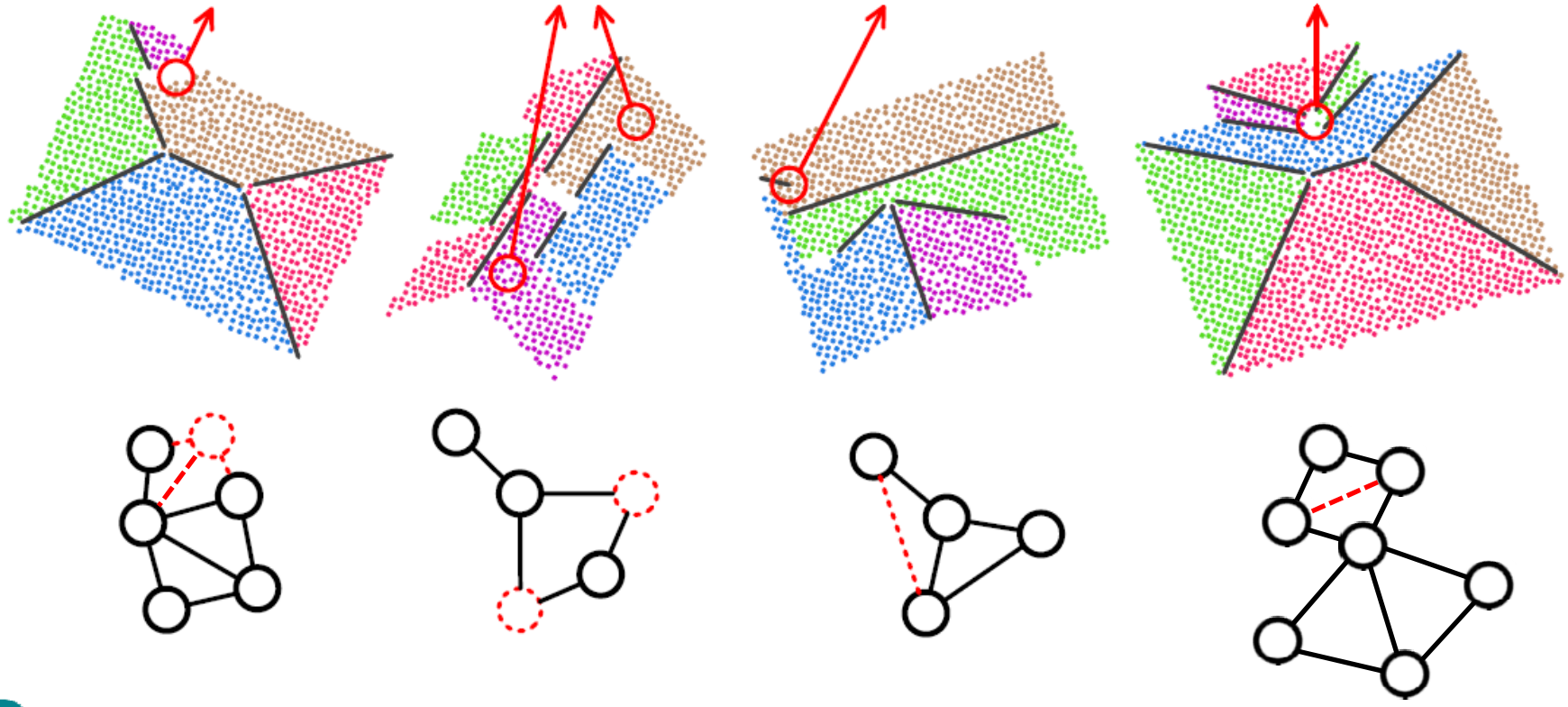
ERRORS IN ROOF TOPOLOGY GRAPHS

Missing segment

Wrong segment

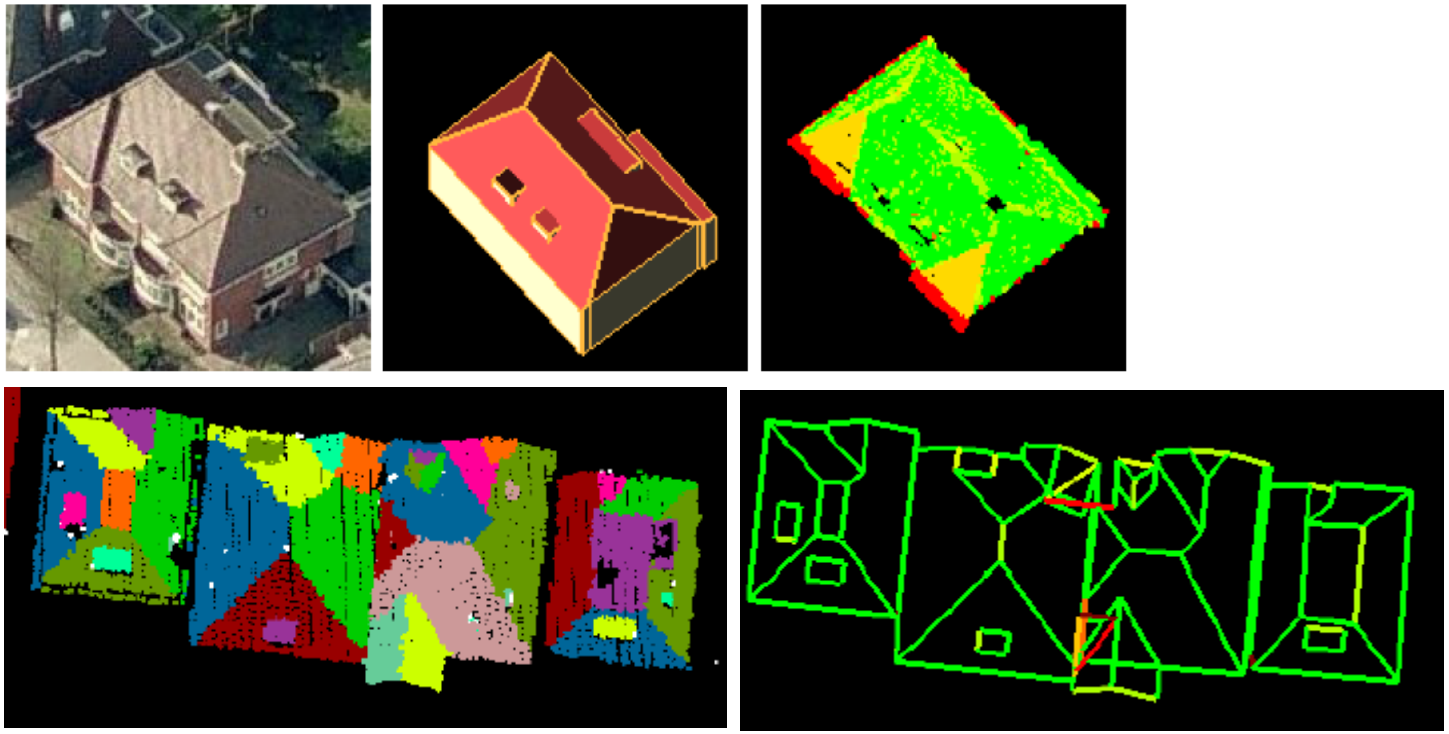
Wrong intersection line

Missing intersection line

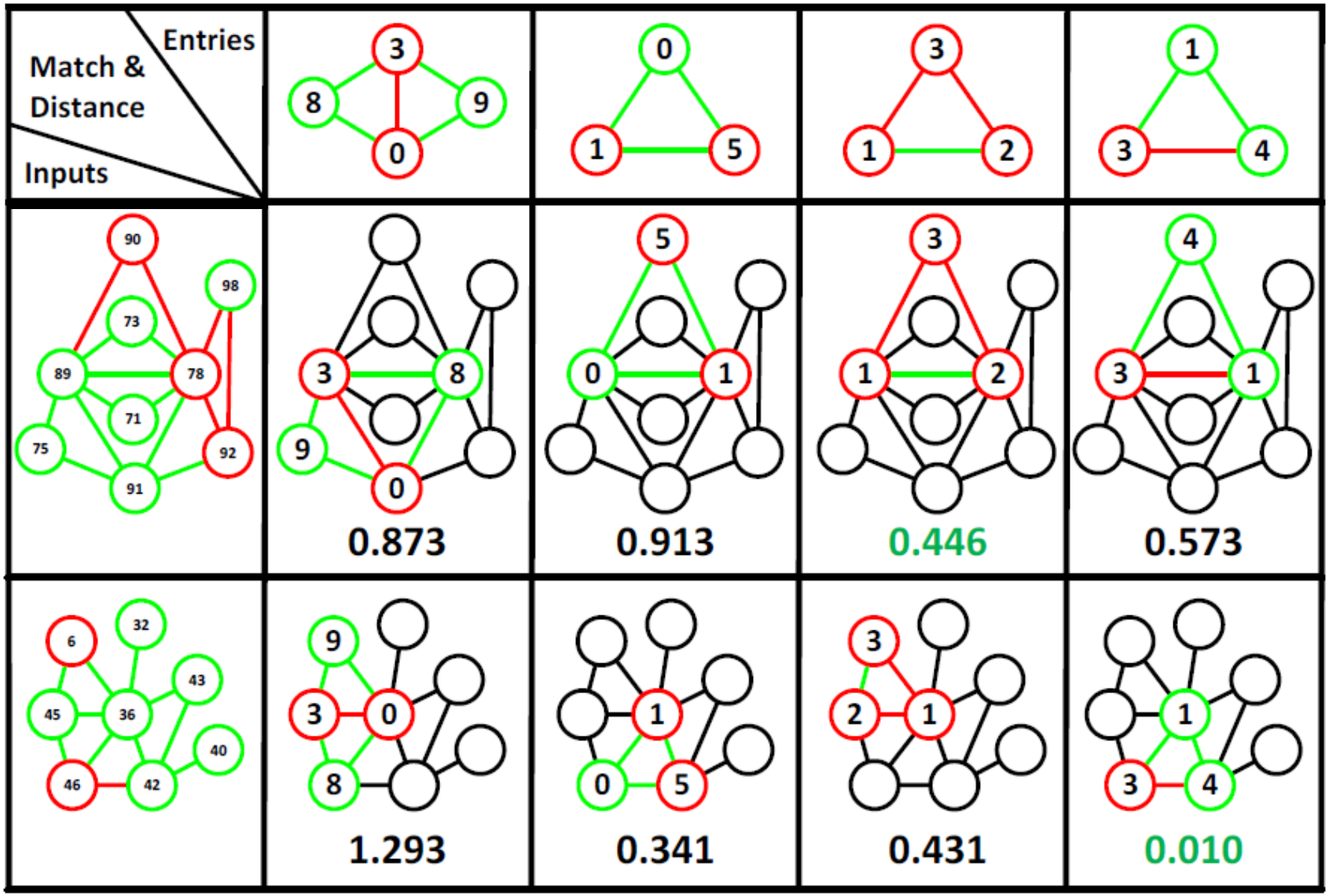


CORRECTING ERRORS IN ROOF TOPOLOGY GRAPHS

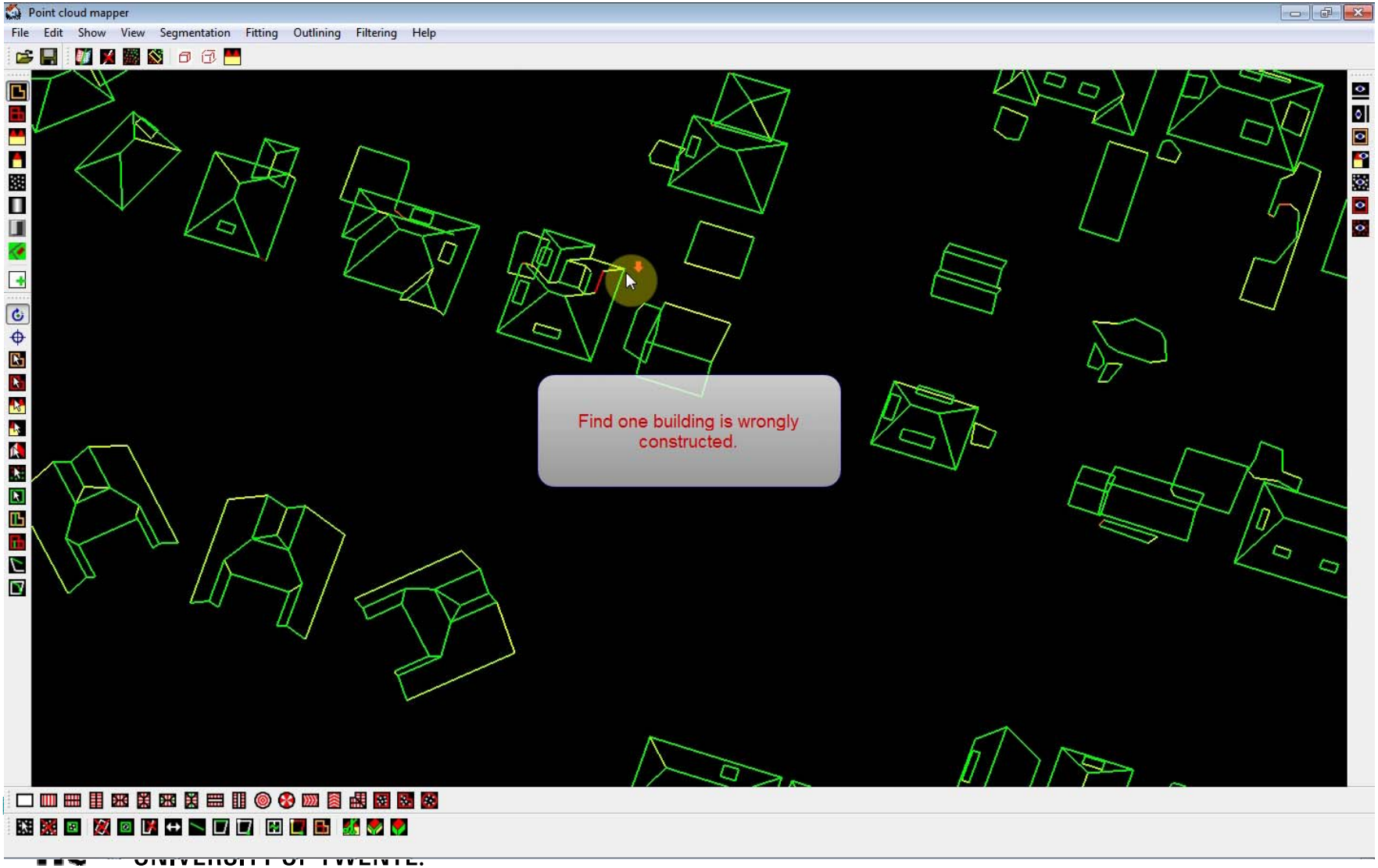
- Interactive editing of roof topology graphs
- Recognition of error type – reapplication of earlier graph edits
- Analyse model quality of roof faces and edges



ERROR RECOGNITION

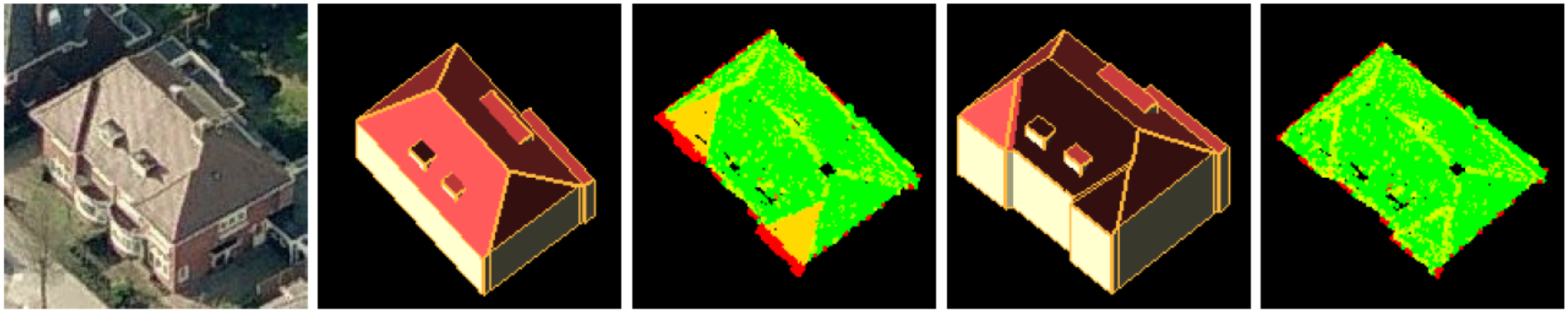


INTERACTIVE CORRECTION OF REMAINING ERRORS



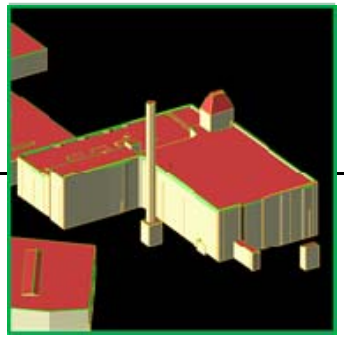
RECONSTRUCTION PROCESS

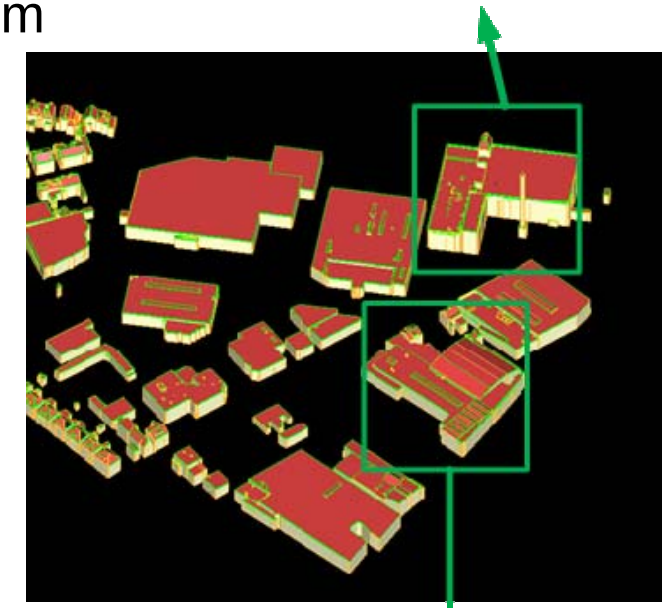
- Automated reconstruction with target graph library
- Iterate
  - Analysis of model quality
  - Automated improvement of errors by matching against entries of error library
- Interactive editing of remaining errors

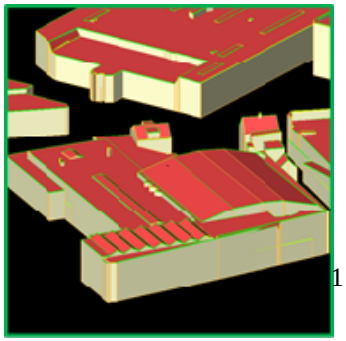


LOD2 MODELLING RESULTS

- 95% buildings correctly modeled
- PhD work Biao Xiong – www.dipper3d.com







FEASIBILITY OF NATIONWIDE LOD2 BUILDING MODELLING

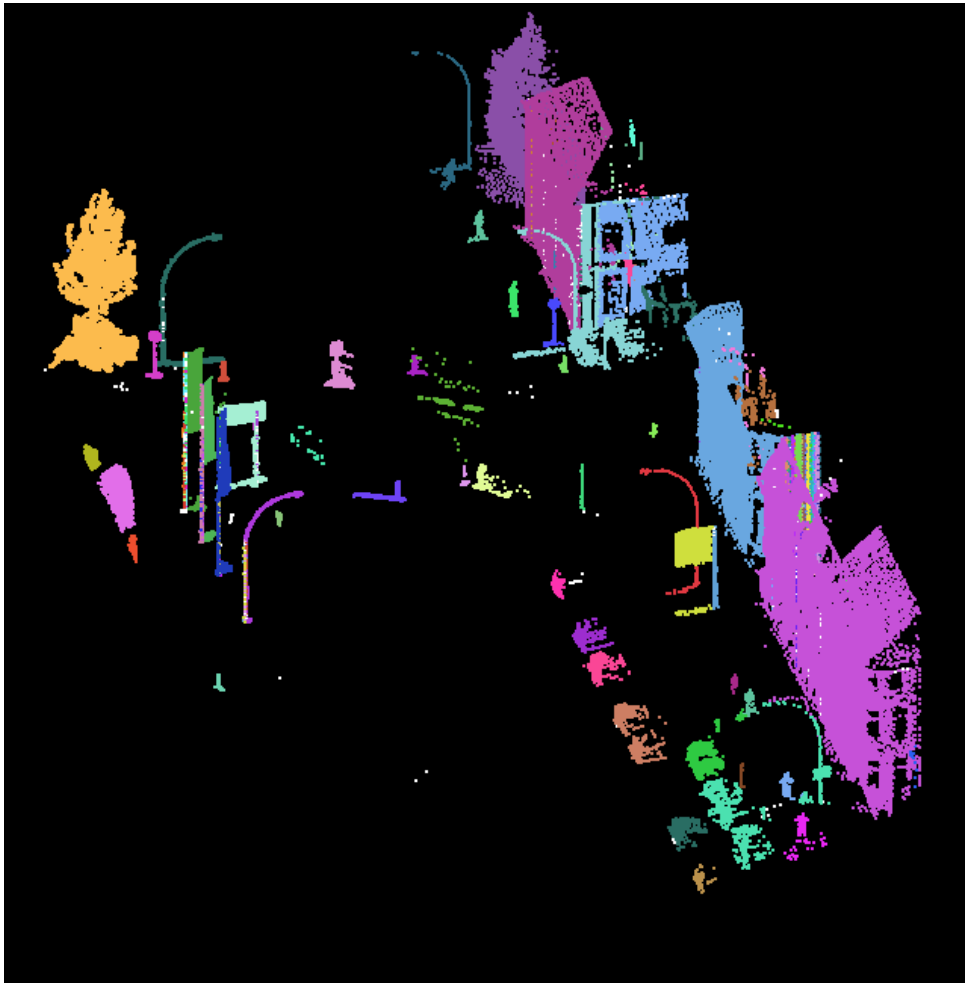
- 9366 building models reconstructed in Enschede
  - 45 minutes CPU time for automated reconstruction
  - 1 working day for interactive editing of building models

- Scaling up to nationwide LOD2 modelling (4 million building models)
  - 13 days CPU time for automated reconstruction
  - 2 years for interactive editing of building models

STREET FURNITURE EXTRACTION

Standard processing scheme – mobile laser scanning data

- Segment point cloud into planar pieces
- Remove ground segments
- Connected components of remaining points
- Classification



STREET FURNITURE CLASSIFICATION

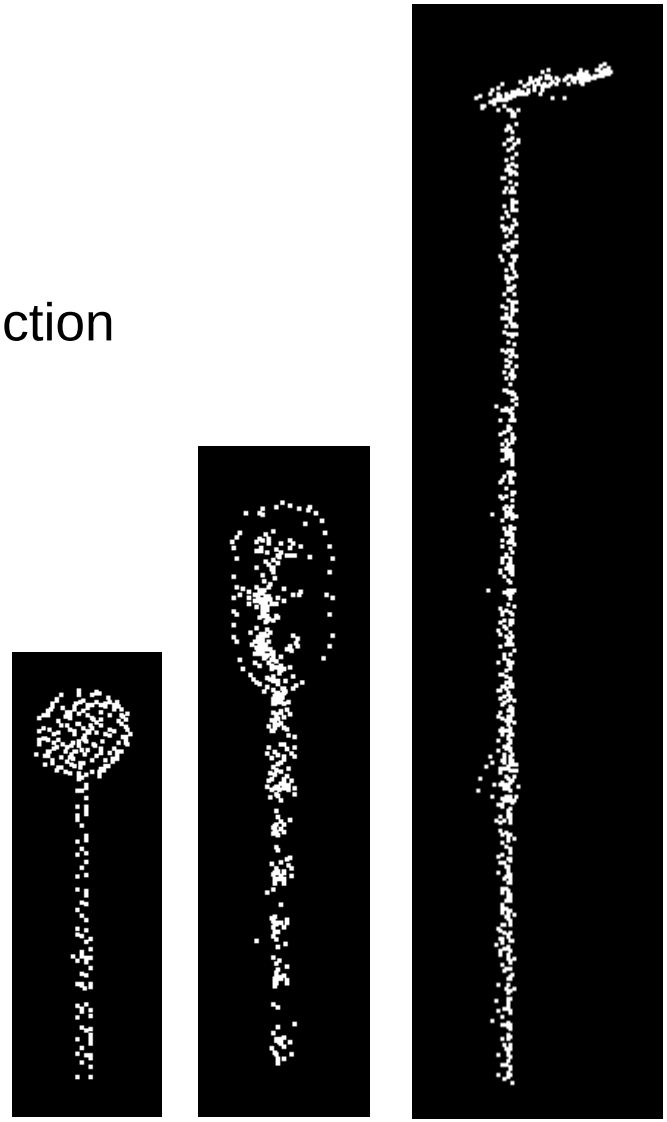
Feature extraction

- Geometric features (height, width)
- Spin images
- Relationships: distance to road side, junction

Classification

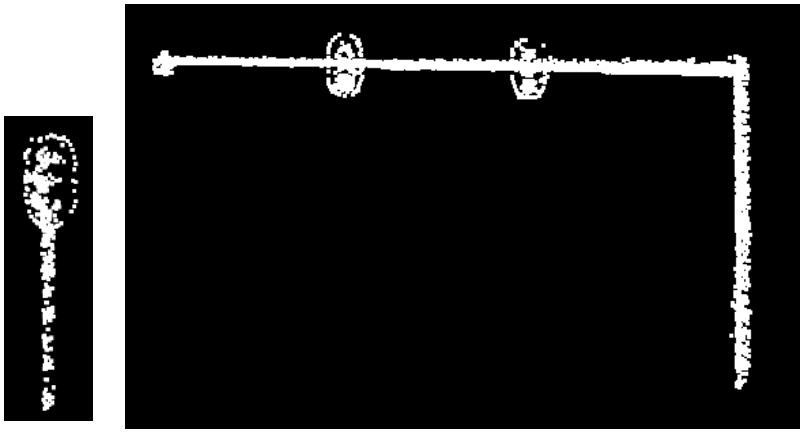
- Support vector machines
- Implicit shape models

Low accuracy (60-70%)

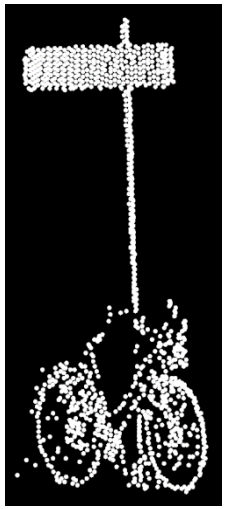


PROBLEMS WITH COMPONENT BASED CLASSIFICATION

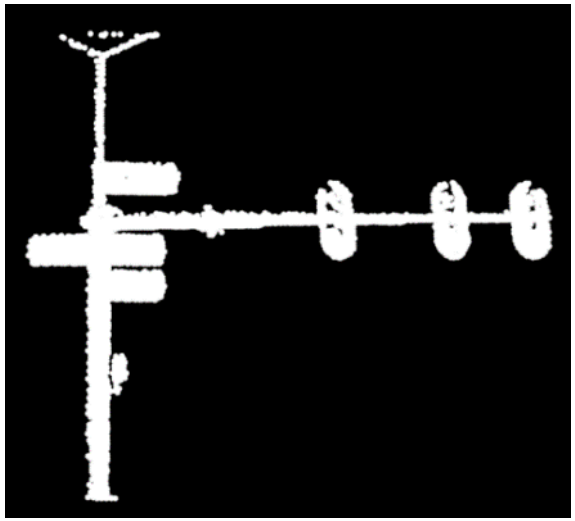
- Intra class variability



- Connected objects

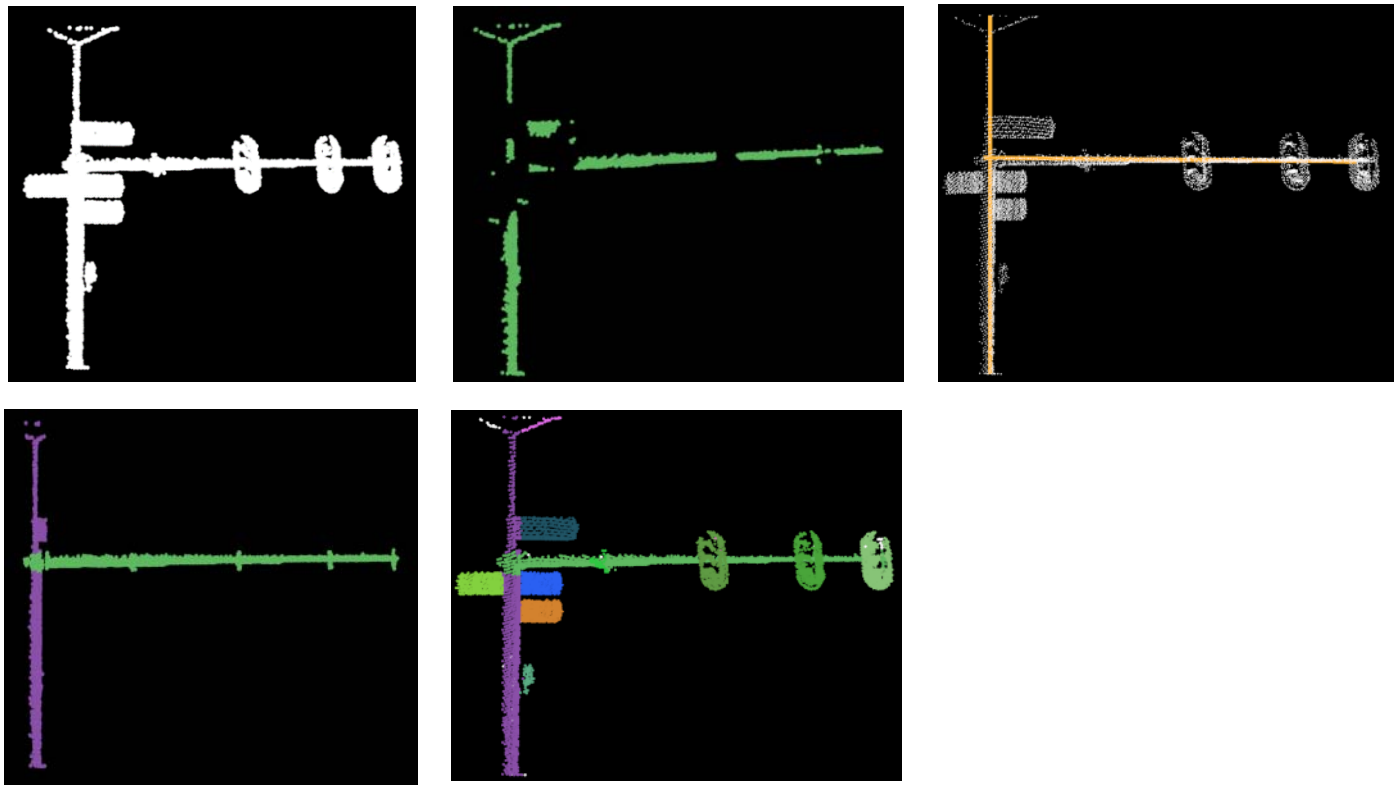


- Multiple use

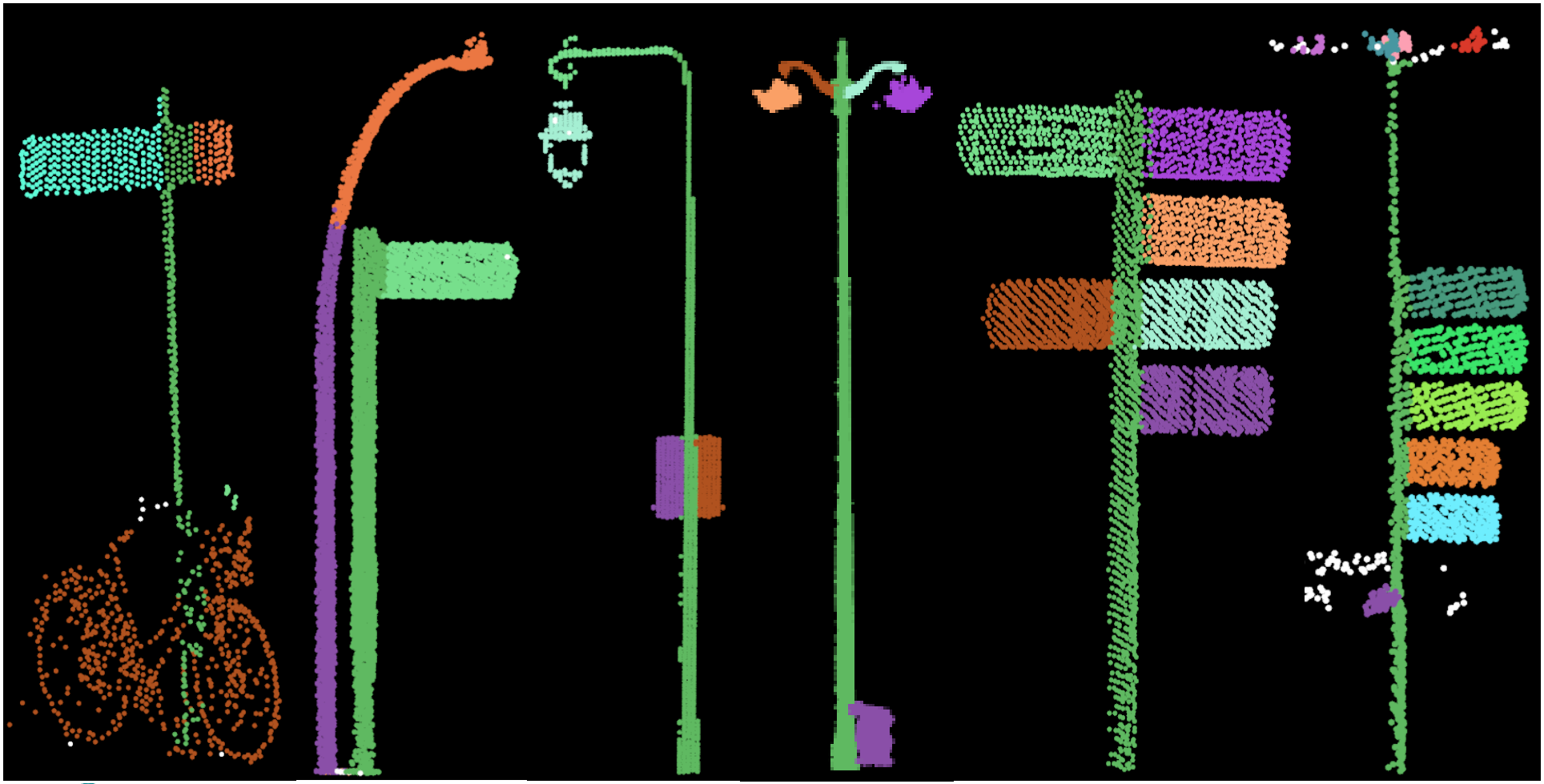


DECOMPOSITION OF CONNECTED COMPONENTS

- Different approaches, depending on pole width and number of attached objects



SOME RESULTS



CONCLUDING REMARKS

- Nationwide LOD2 modelling
  - Editing is still time consuming
  - Further editing experience may improve automated corrections
  - Point clouds from dense matching

- Street furniture classification
  - Decomposition into poles and attached objects
  - Some refinement and regrouping of attached objects
  - Classification of objects