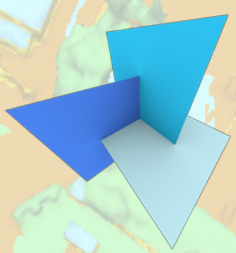

3D geoinformation

Department of Urbanism
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Delft University of Technology

cyclomedia

Contextual Classification of 3D Textured Meshes for Urban Scene Interpretation

Weixiao Gao, Malgorzata Jarzabek-Rychard, Martin Kada, Hugo Ledoux, Liangliang Nan, Thijs van Lankveld

02/10/2018

TU Delft

Contents

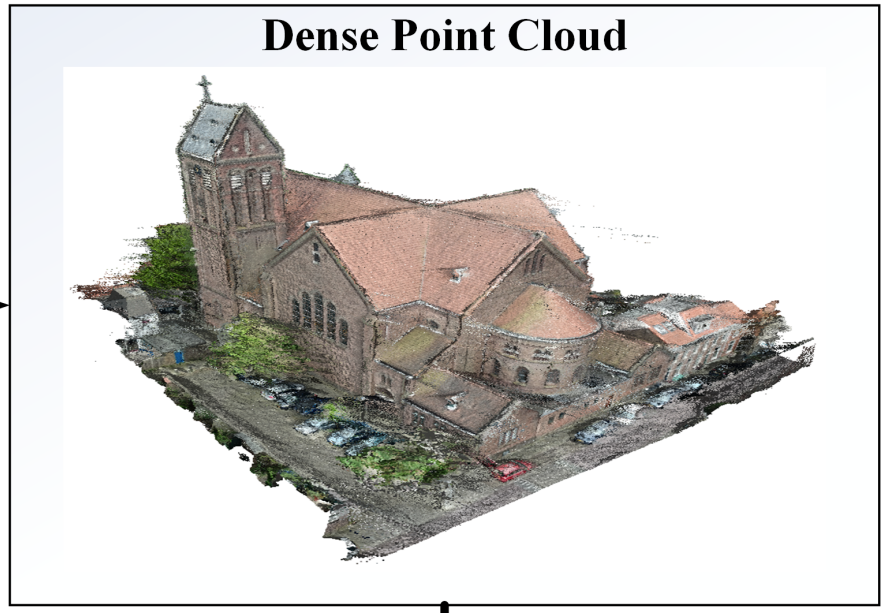
1. Introduction

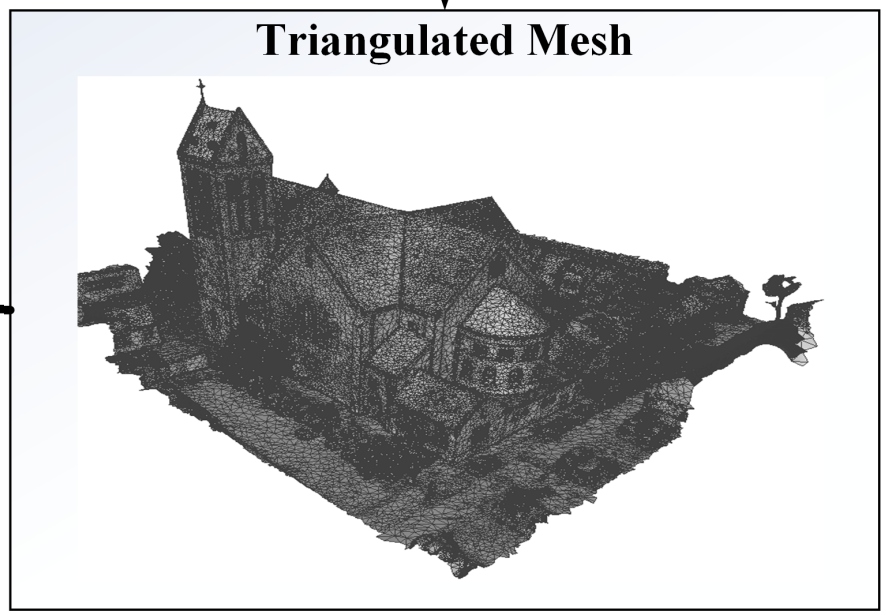
1. Introduction

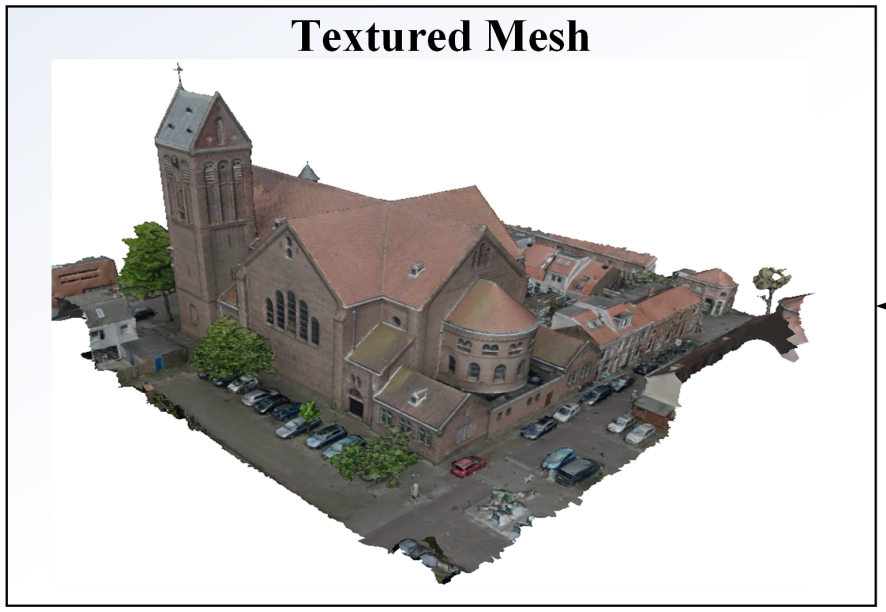
Figure: Top: Street View 360; Middle: Water View 360; Bottom: left ortho, right: oblique

1. Introduction

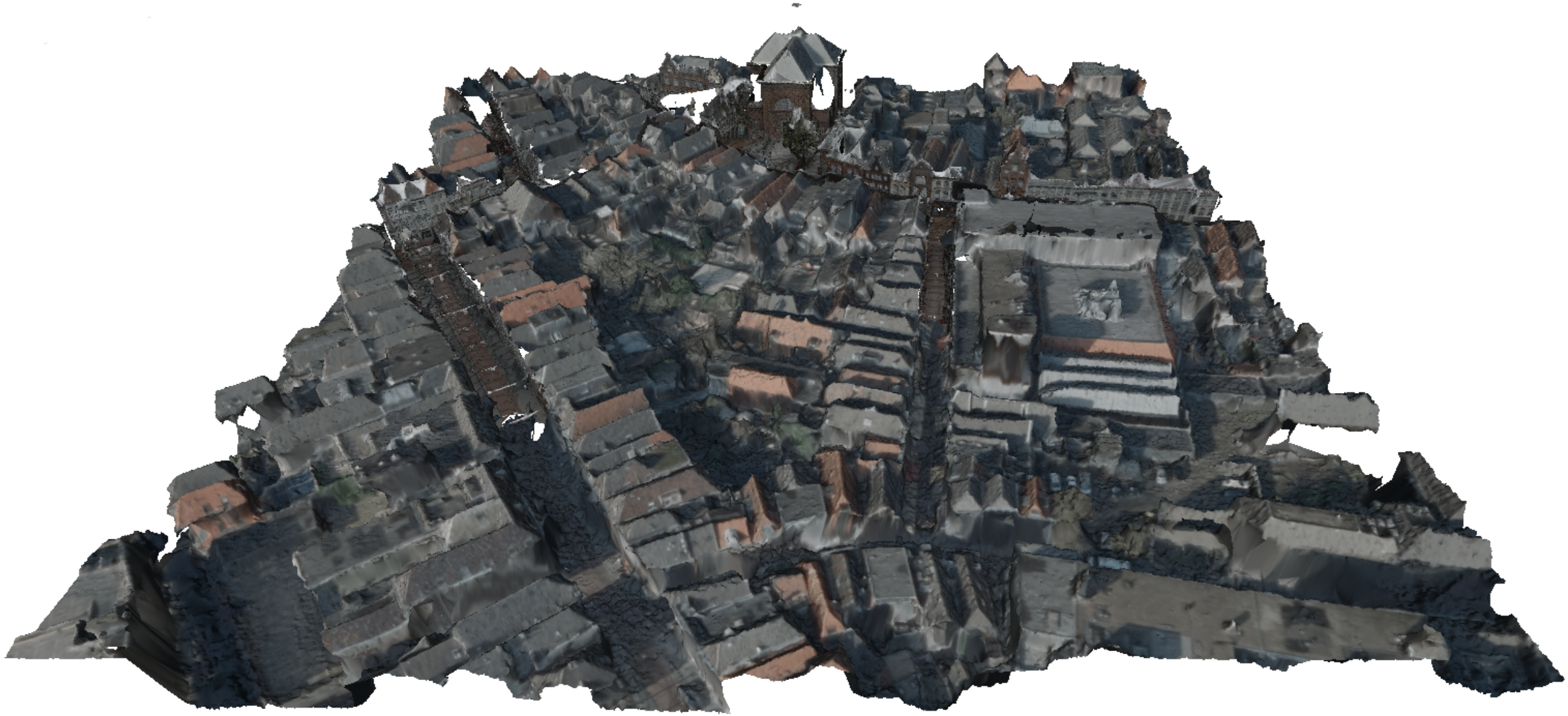
Textured mesh generation pipeline:







1. Introduction

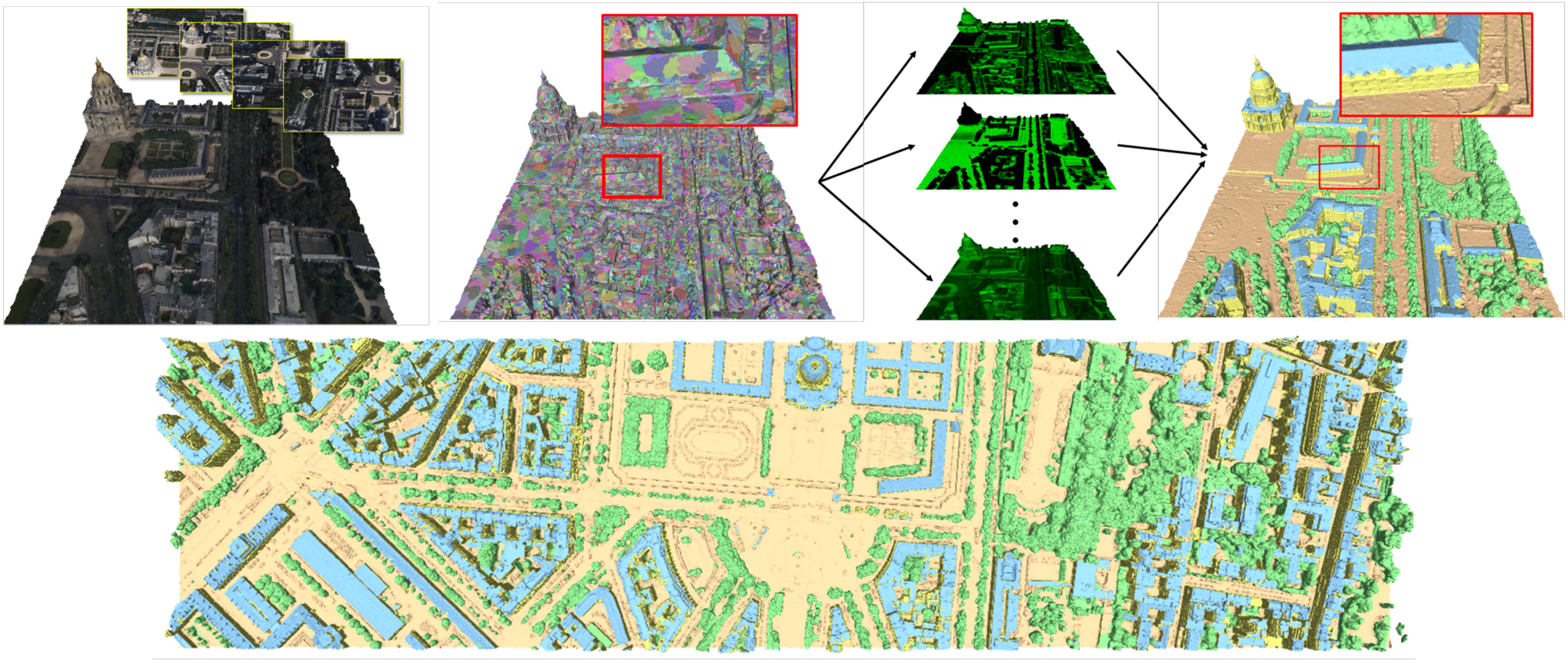


1. Introduction

2. Related Work

2. Related Work

Textured Meshes Classification of Urban Scene.



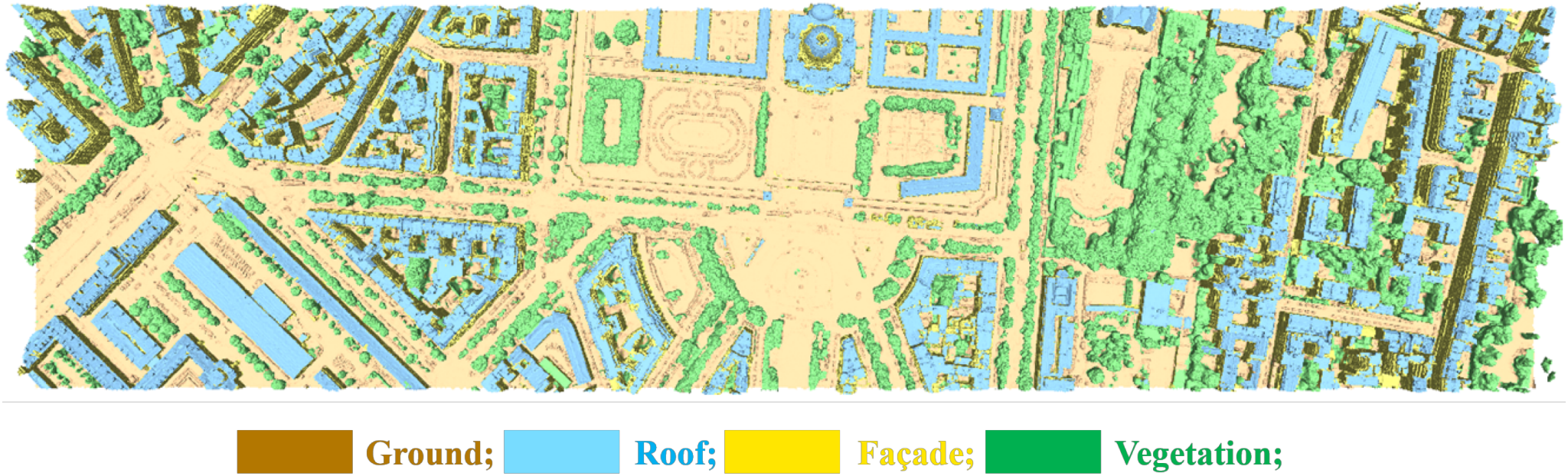
(Verdie et al., 2015, Mohammad et al., 2017)

2. Related Work

1. **Textured Mesh** Classification of Urban Scene.

Defects:

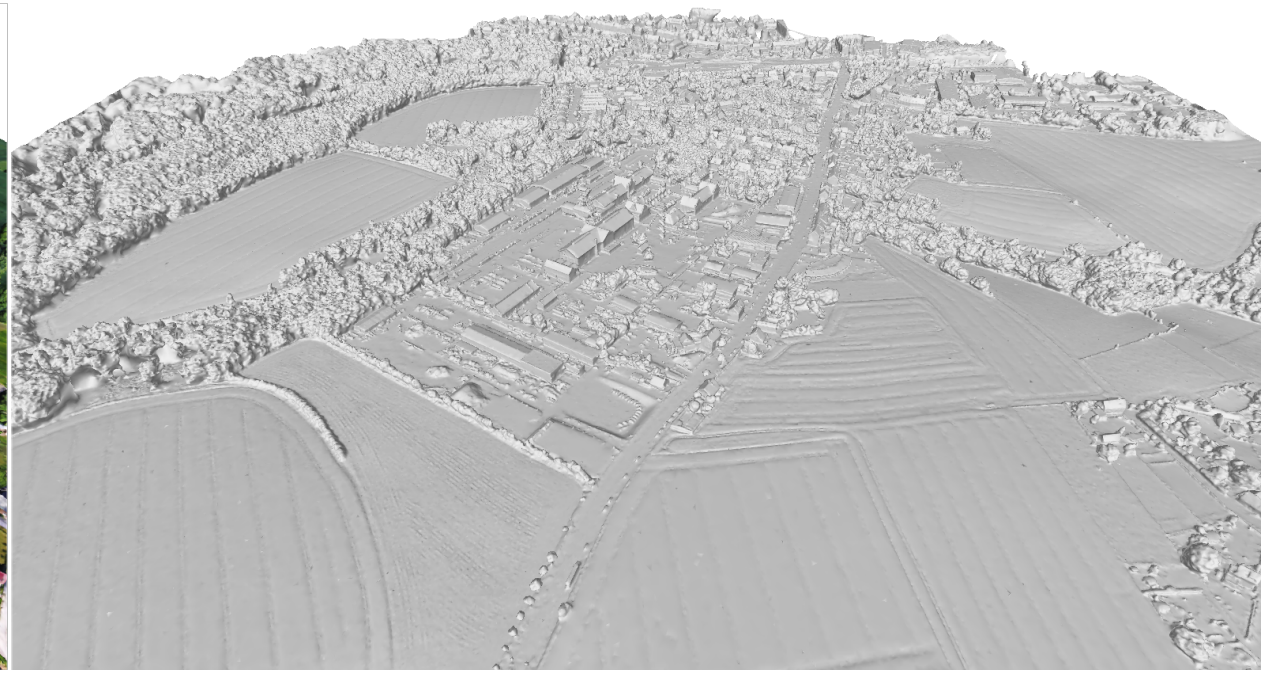
- Time Consuming.
- Inaccurate results.
- Lack of validation with ground truth.



(Verdie et al., 2015, Mohammad et al., 2017)

3. Methodology

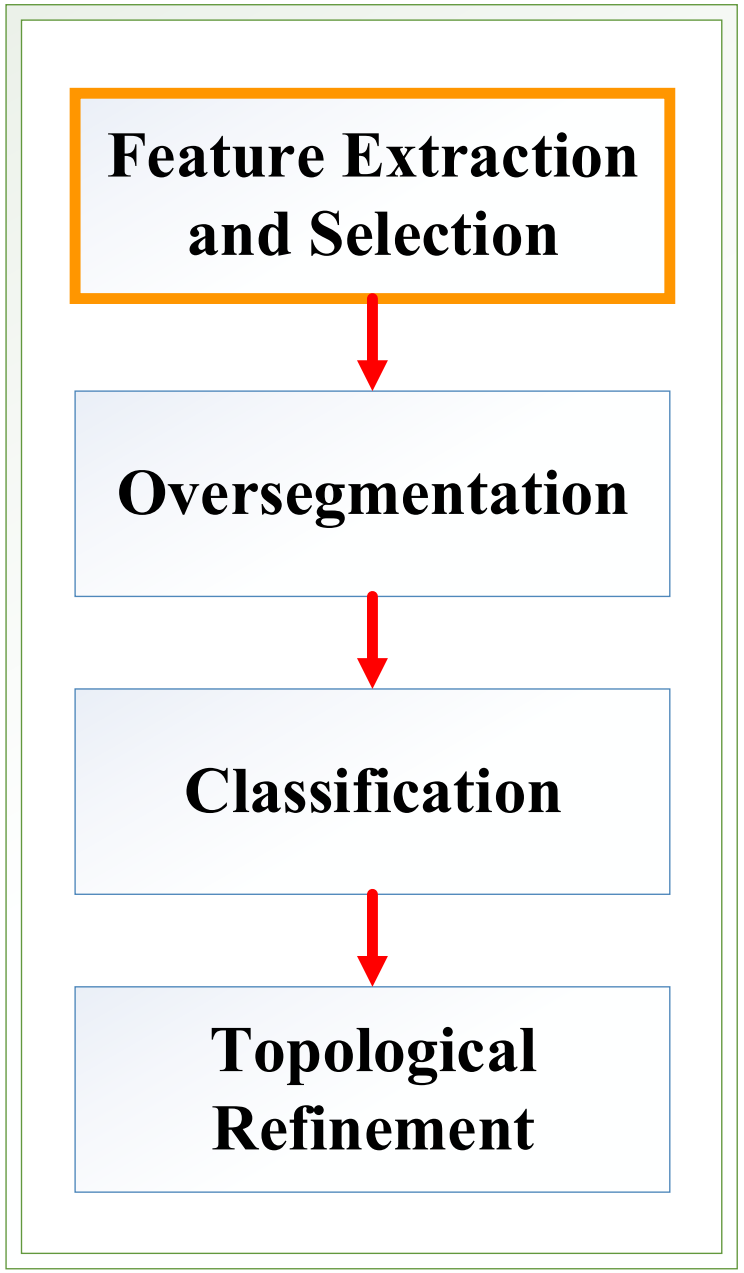
3. Methodology



Meshes of Dortmund Zeche Zollern (includes 3,030,483 vertices and 5,982,694 triangles)

ISPRS-Commision I: ICWG I/II Benchmark data "Dortmund". Textured mesh generated from Bentley/Acute3D 4.0.
http://www2.isprs.org/commissions/comm1/icwg15b/benchmark/Benchmark_Aim.html

3. Methodology



❖ Extraction of Multi-Level Geometry Based Features:

❖ Elevation: $$a_e(f_i) = \sqrt{\frac{z_i - z_{min}}{z_{max} - z_{min}}}$$

❖ Planarity: $$a_p(f_i) = \sqrt{\frac{c_i - c_{min}}{c_{max} - c_{min}}}$$

❖ Verticality: $$a_v(f_i) = 1 - |\mathbf{n}_i \cdot \mathbf{n}_z|$$

❖ Extraction of Radiometric Based Features:

❖ Greenness Index: $$a_g(f_i) = G - 0.39 \cdot R - 0.71$$

3. Methodology

Feature Extraction and Selection

↓

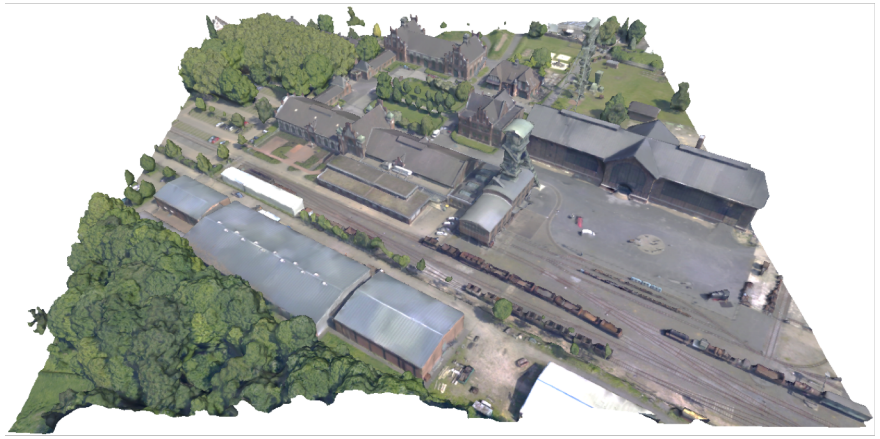
Oversegmentation

↓

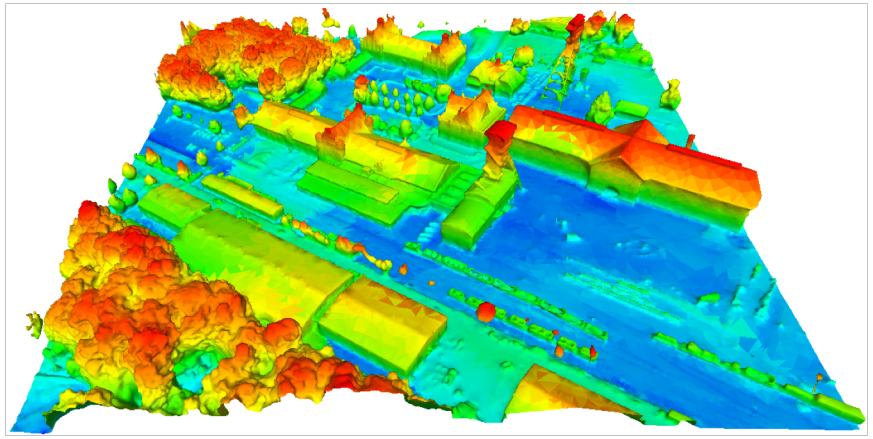
Classification

↓

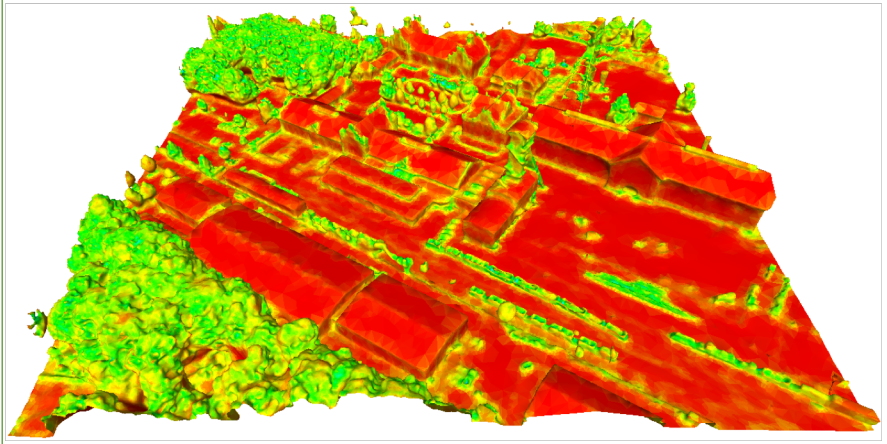
Topological Refinement



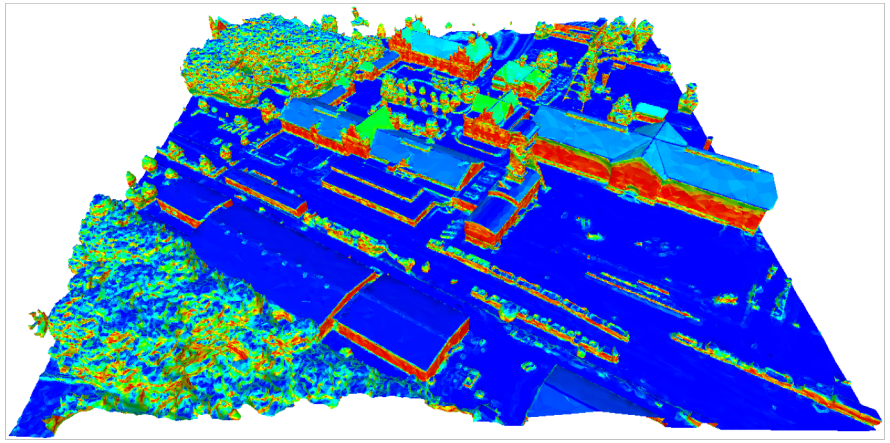
(a) Single texture triangular mesh tile



(b) Elevation feature



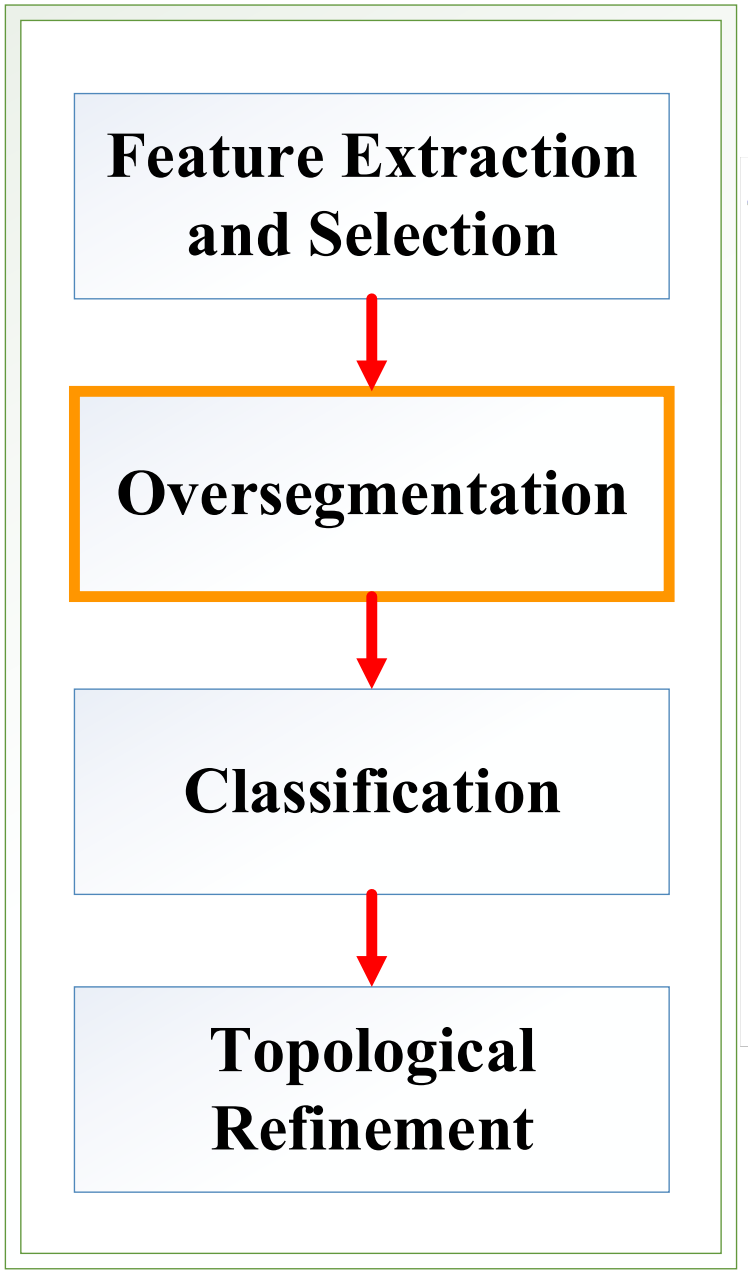
(c) Planarity



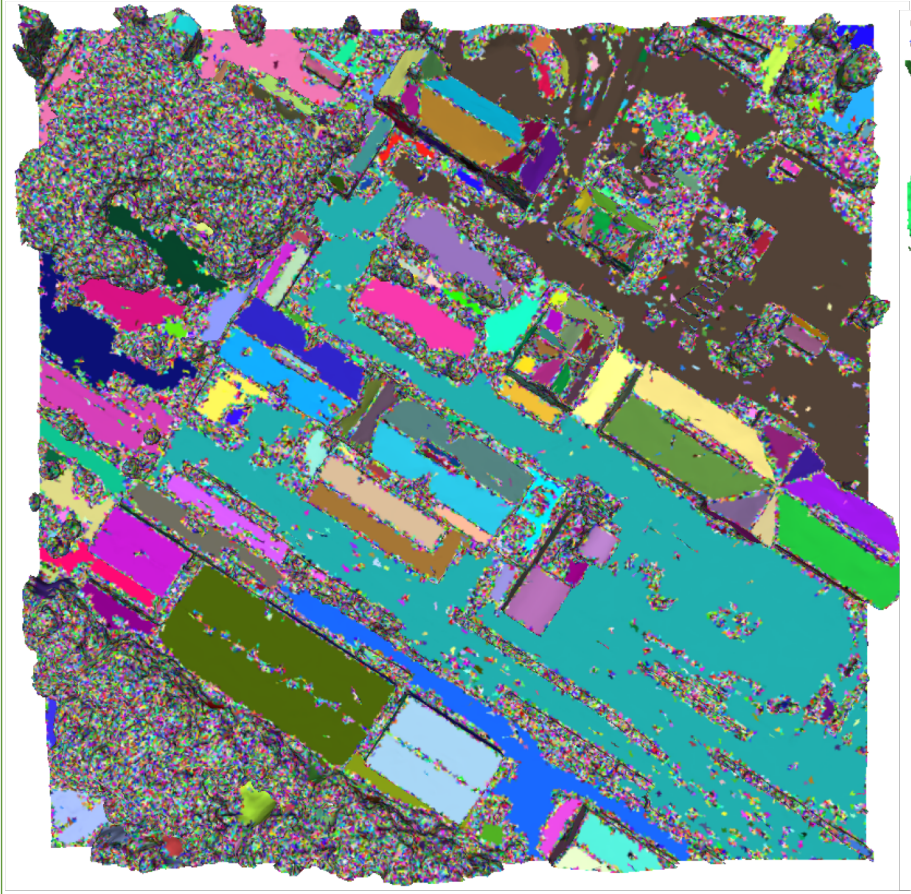
(d) Verticality

Low  High

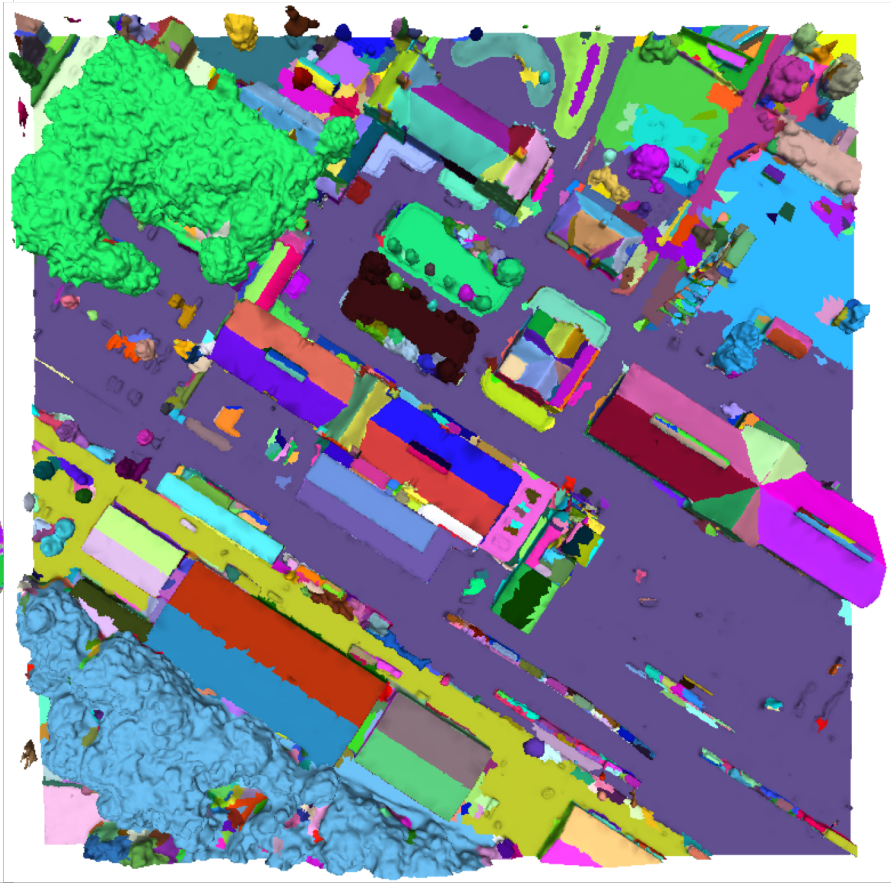
3. Methodology



Over-segmentation comparison



(a) Curvature-based region growing



(b) Multi-features region growing

3. Methodology

Feature Extraction and Selection

↓

Oversegmentation

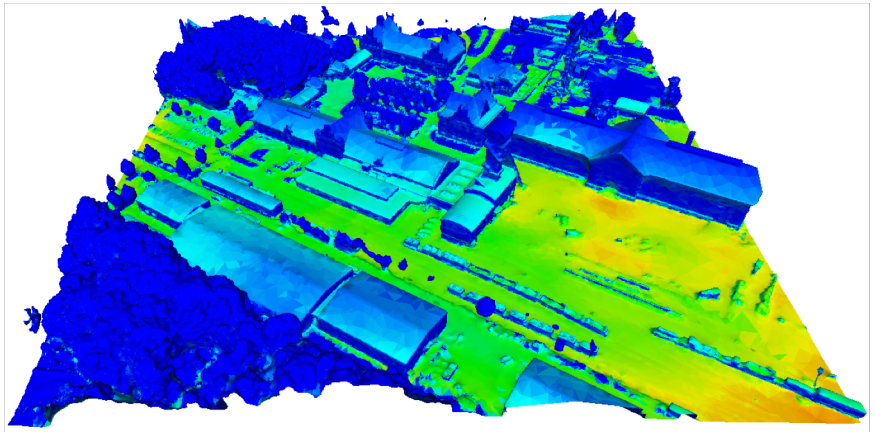
↓

Classification

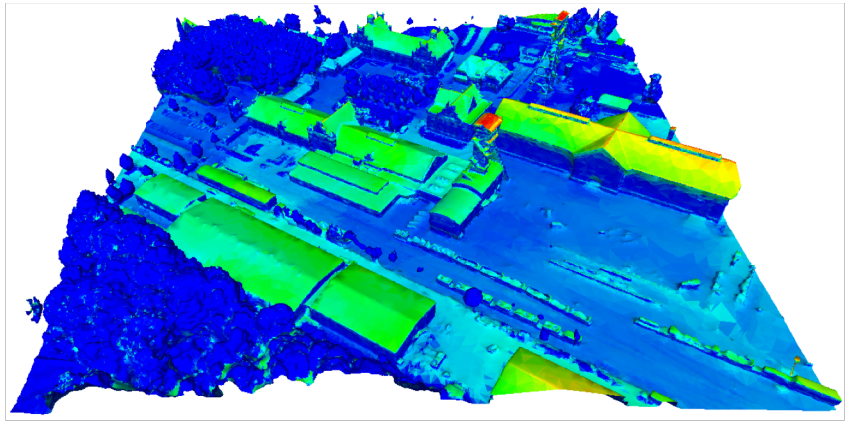
↓

Topological Refinement

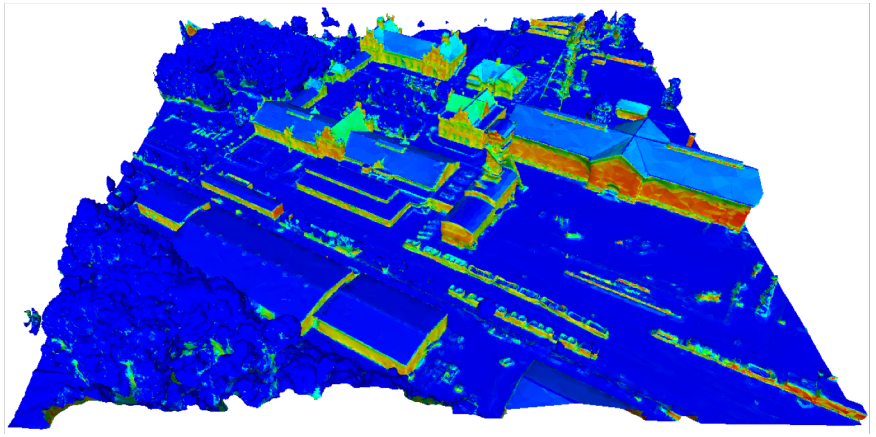
Class Descriptors



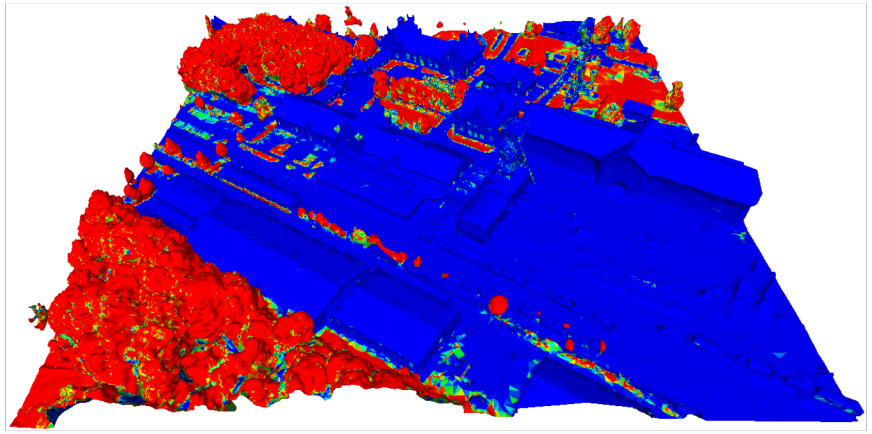
(a) Ground similarity



(b) Roof similarity



(c) Facade similarity



(d) Vegetation similarity (Equal to Greenness features)

Low — High

4.4 Semantic Classification

Feature Extraction and Selection

↓

Oversegmentation

↓

Classification

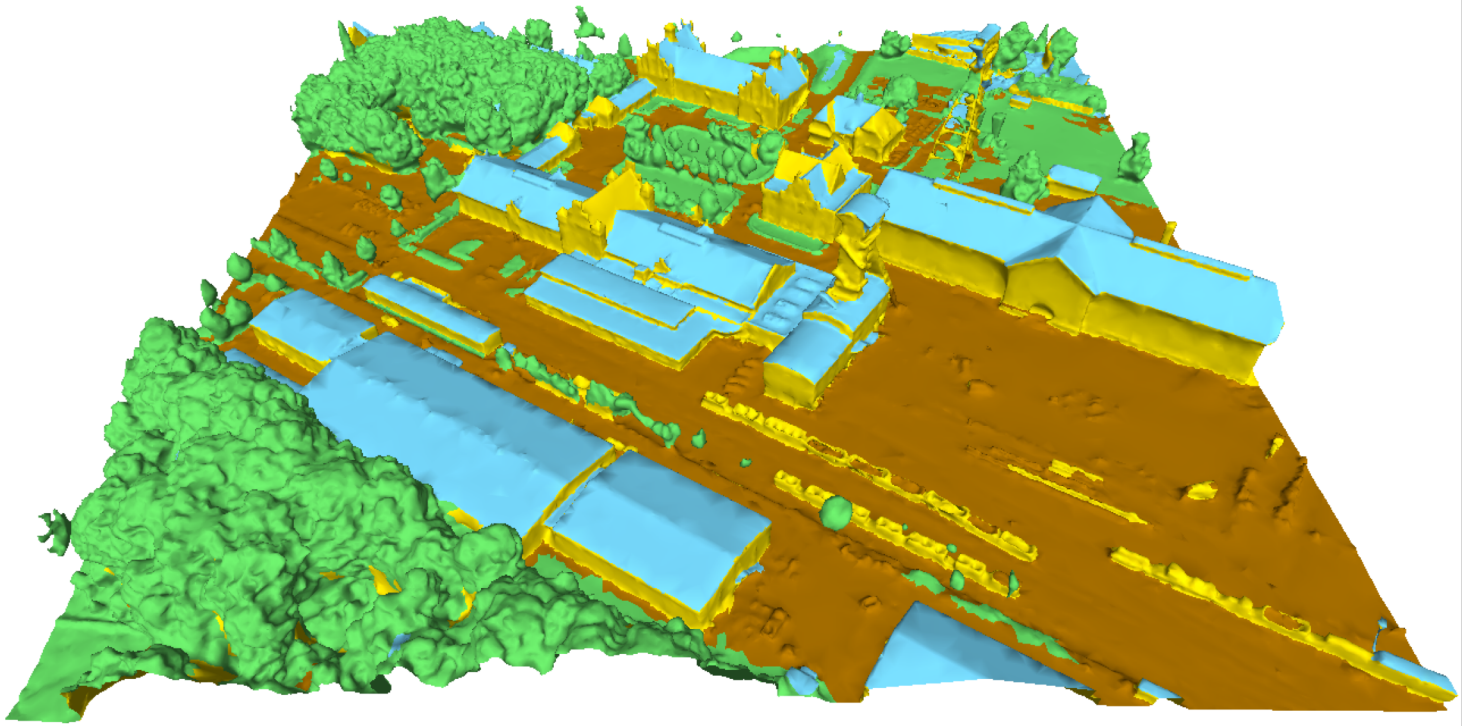
↓

Topological Refinement

❖Markov Random Fields:

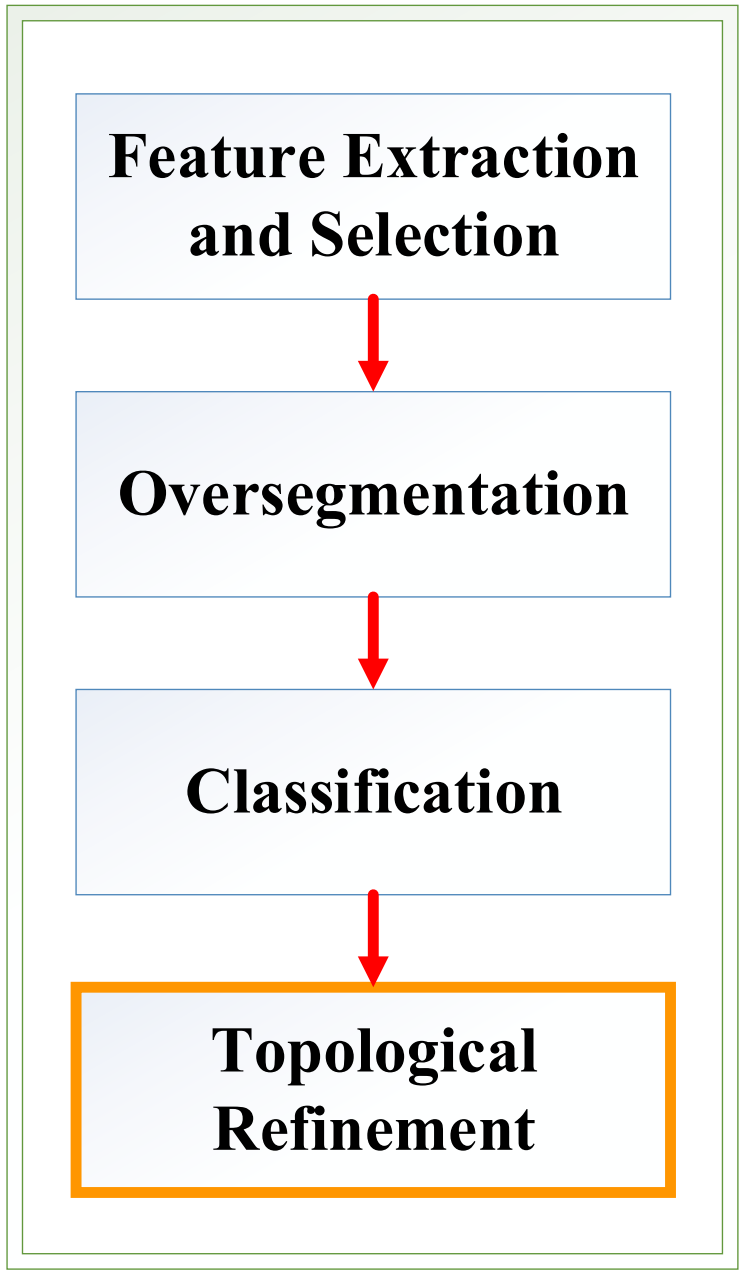
$$U(l) = \sum_{j\epsilon(spf)} D_j(l_j) + \gamma \cdot \sum_{(k,m)\epsilon spf} V_{j=k.j=m}(l_{j=k}, l_{j=m})$$

❖MRF Classification Results:

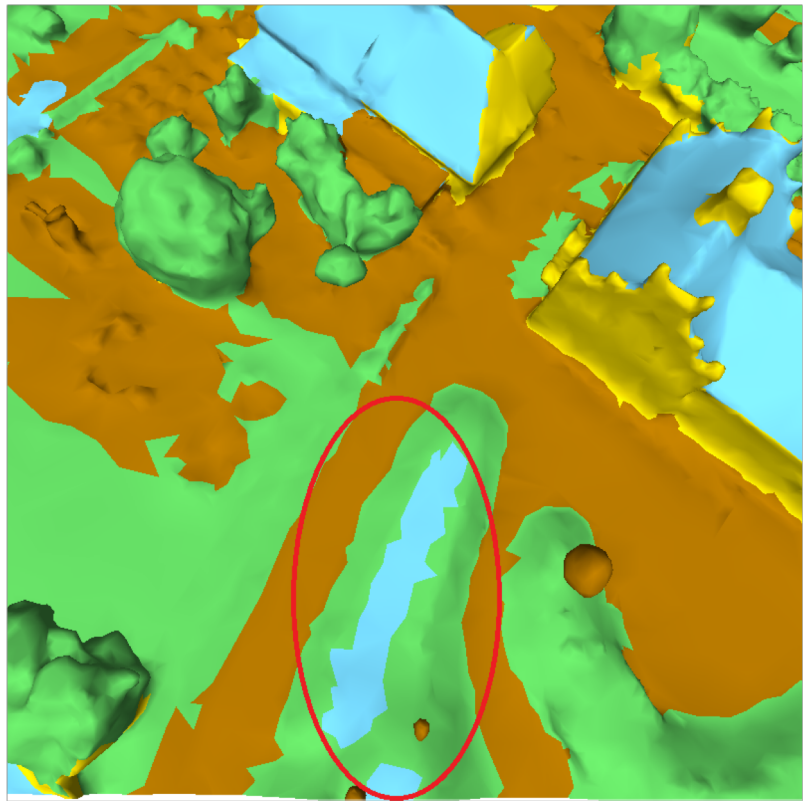


Ground; Roof; Façade; Vegetation;

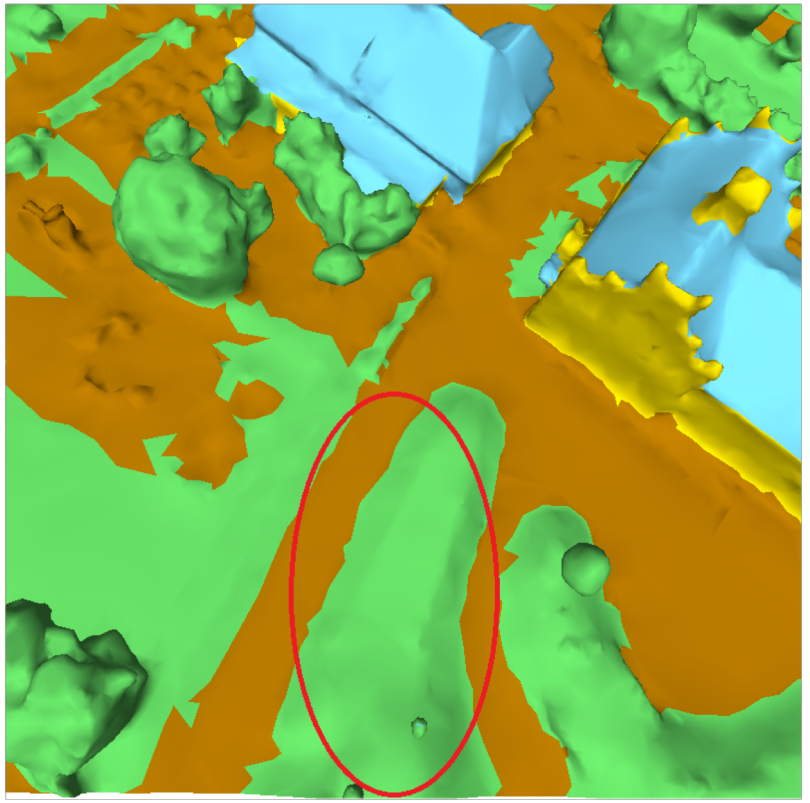
3. Methodology



Roof Refine to Ground



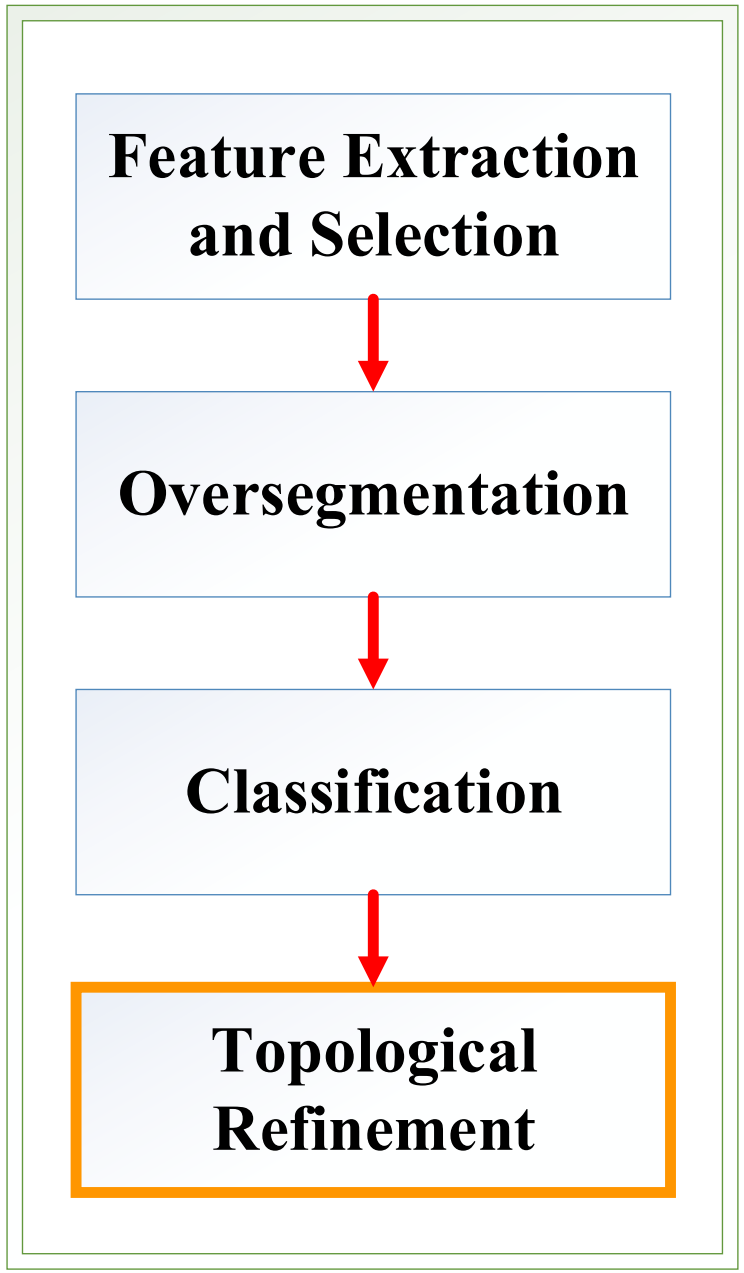
(a) Wrong roof



(b) Refine roof to vegetation

Ground; Roof; Façade; Vegetation;

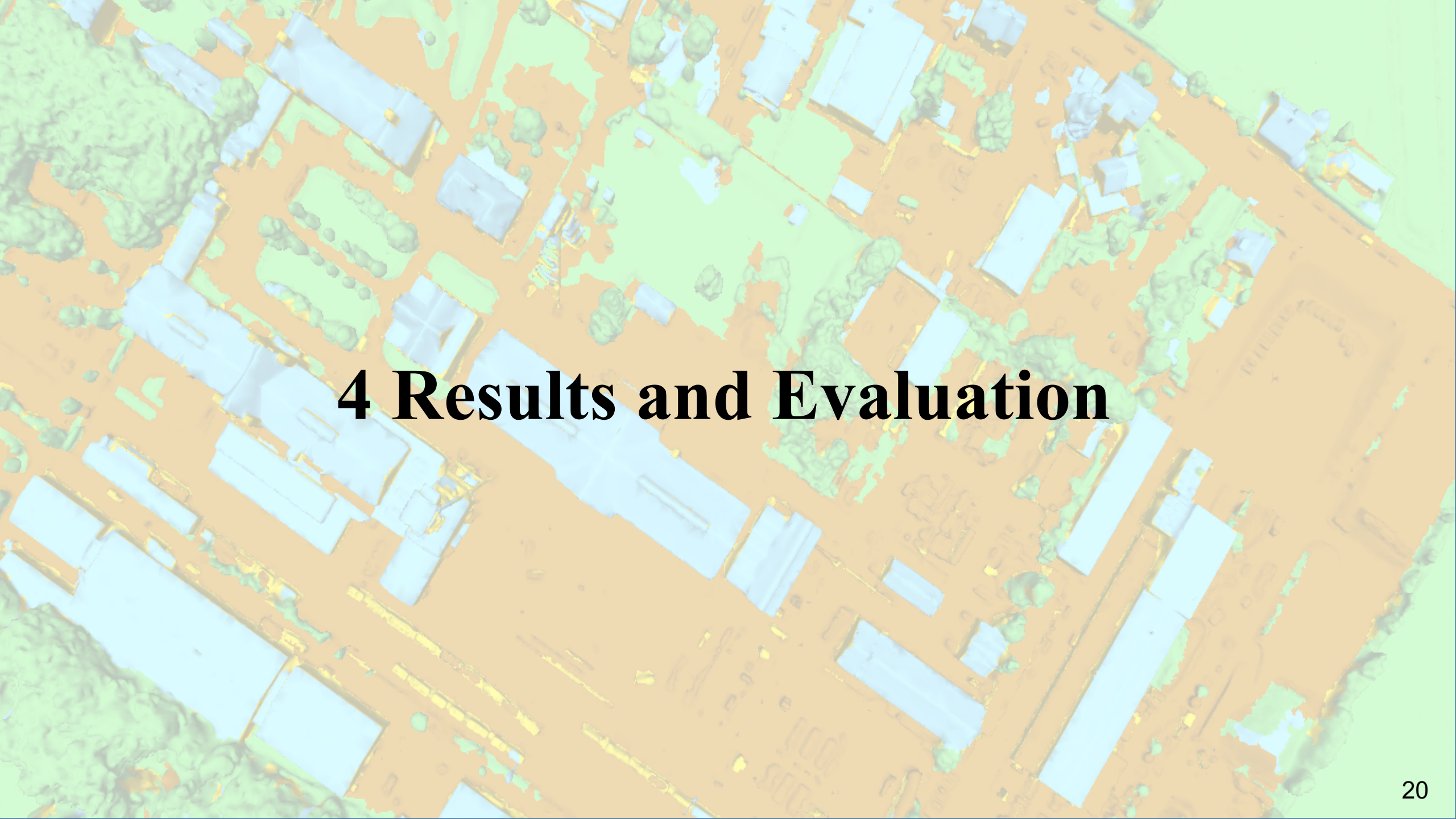
3. Methodology



Topological Refinement Rules

- Geometric
- Semantic Topology

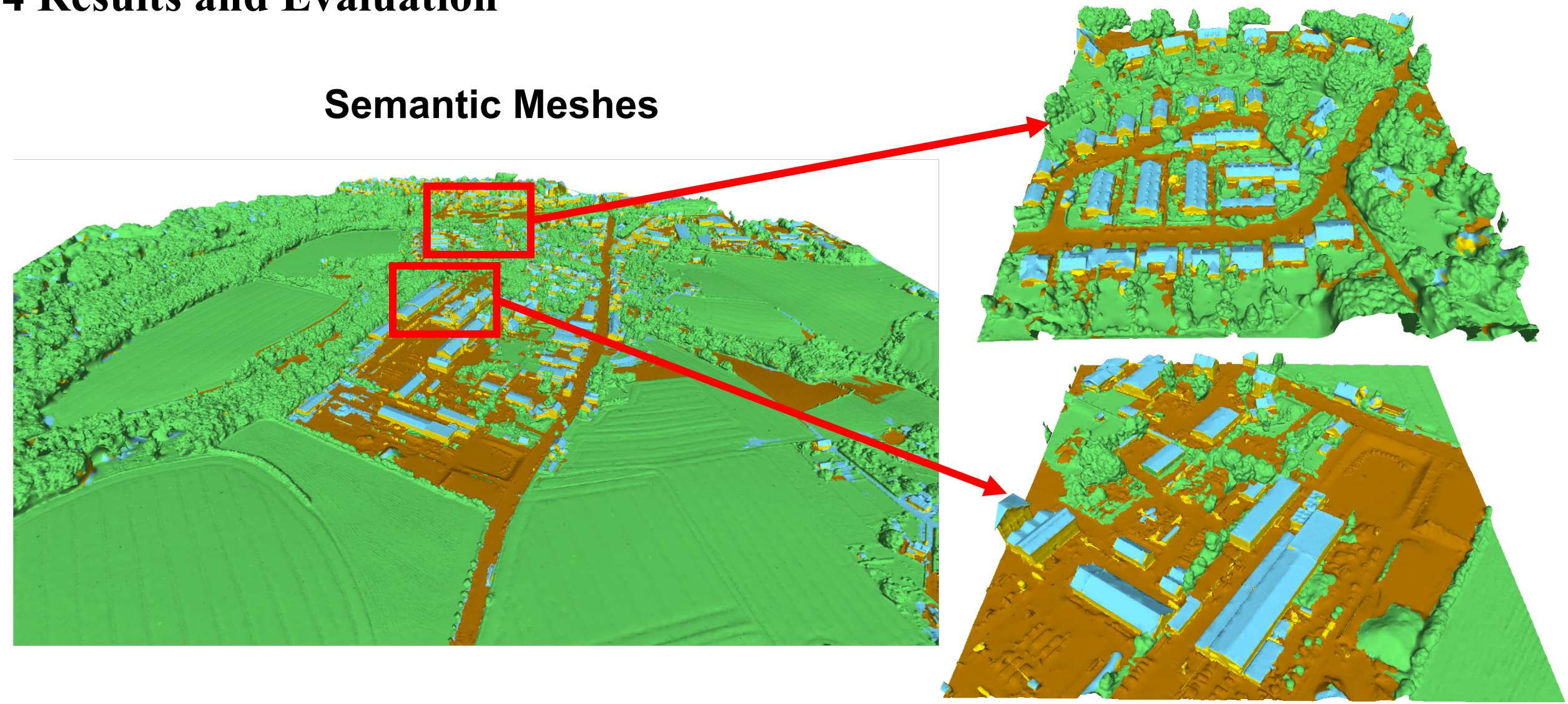
1. Ground to Roof;
2. Facade to Vegetation;
3. Facade to Roof;
4. Roof to Vegetation;
5. Roof to Ground;
6. Vegetation to Roof;



4 Results and Evaluation

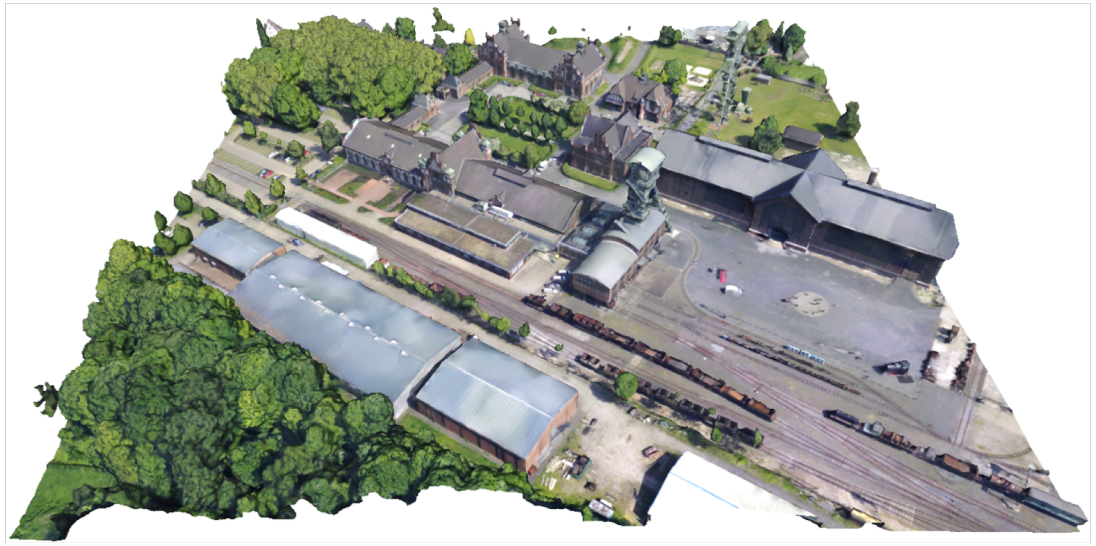
4 Results and Evaluation

Semantic Meshes

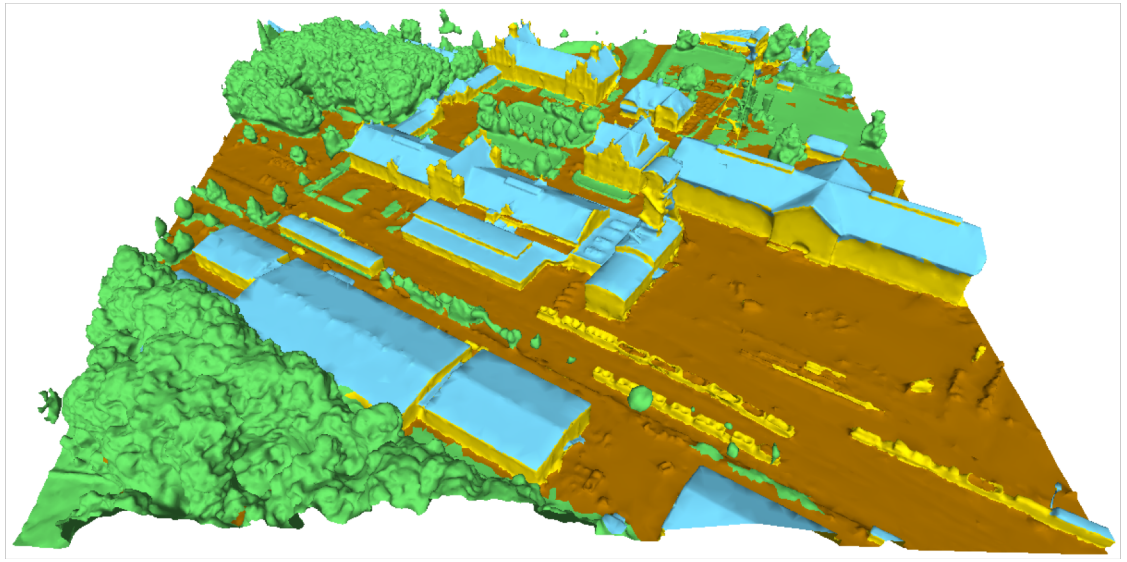


Ground; Roof; Façade; Vegetation;

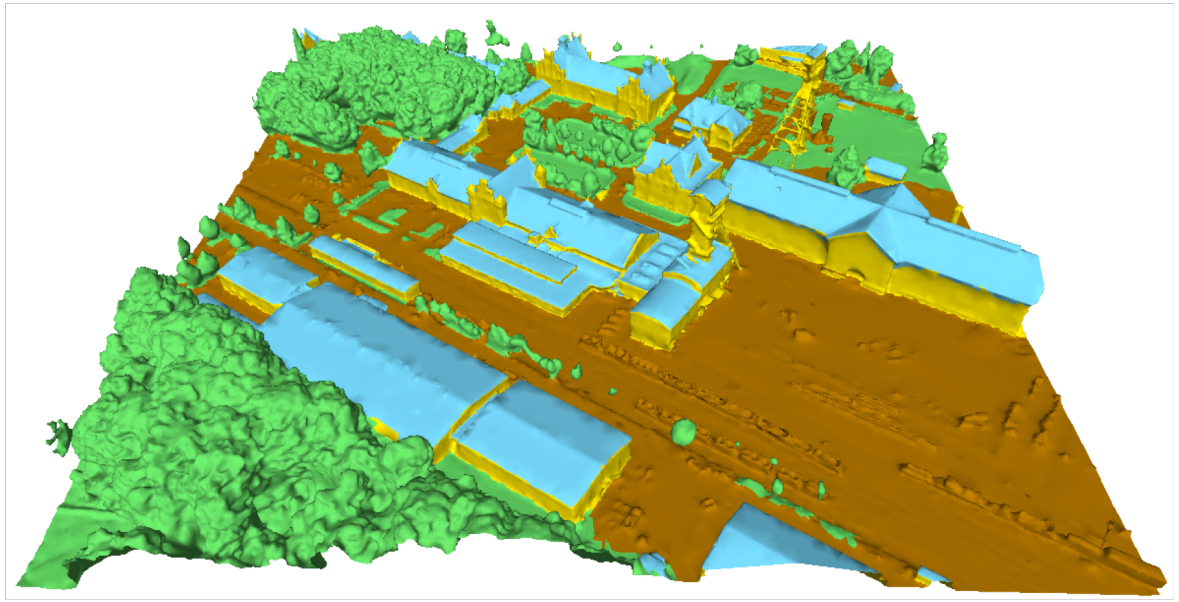
4 Results and Evaluation



(a) Industrial Area

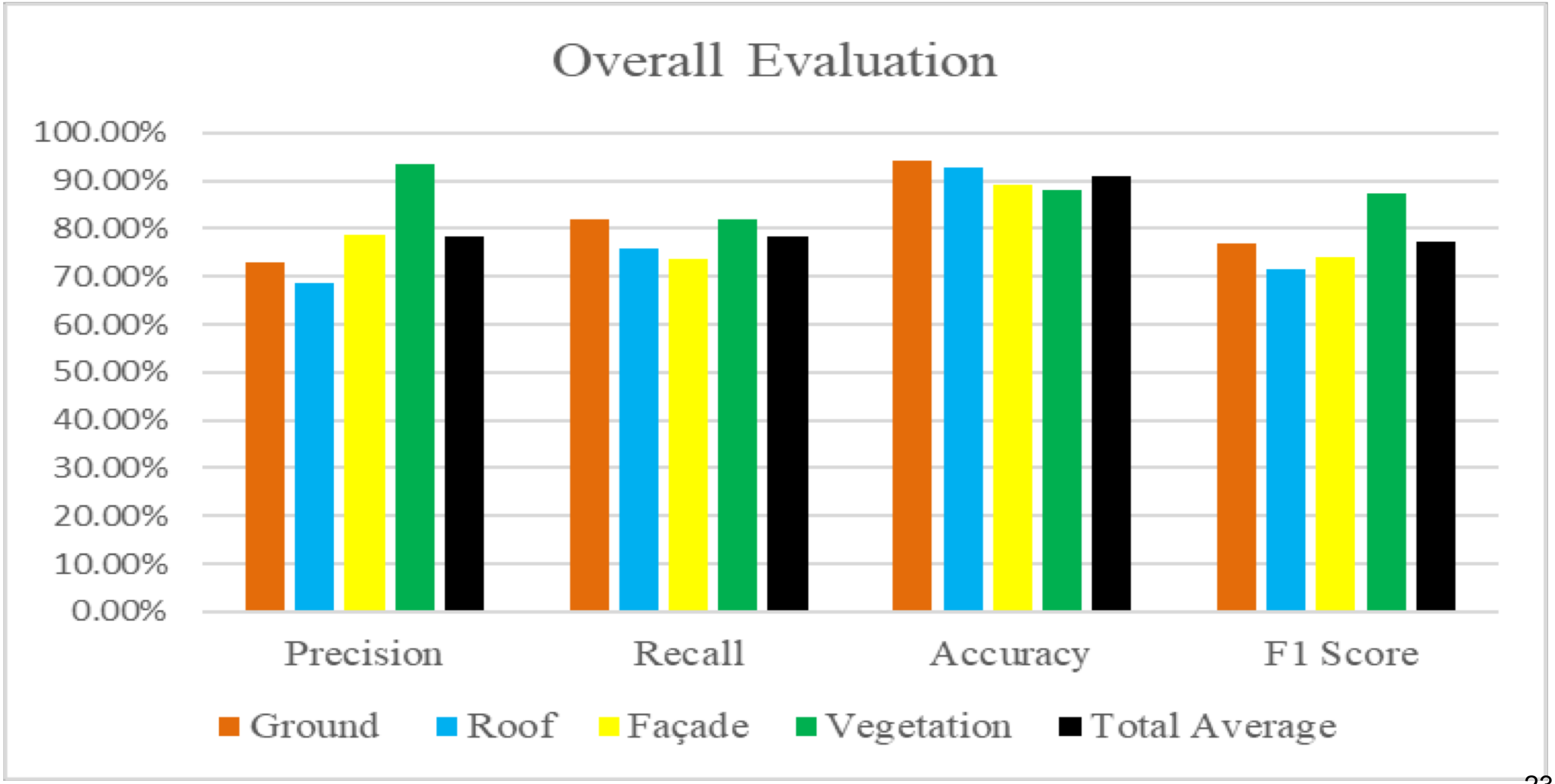


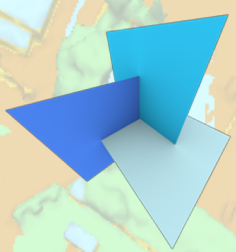
(b) Classification Results



(c) Ground-Truth

4 Results and Evaluation





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Thank you for your attention!

Questions?

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