Automated generalisation of 1:10k topographic data from municipal data

Dogan Altundag & Jantien Stoter
Geo-Product and Process Innovation, Dutch Cadastre
Content

- ‘Key-Registers’ of topography in the Netherlands

- Case: automatic generalisation
  - Reclassification and selection
  - Geometric generalisation
  - Spatial relationship
  - Quality assessment

- Concluding remarks and summary
Key-Registers of topography in the Netherlands

Current situation:

- **Key-register large scale topography at scale 1:1k (BGT)**
  - Provided by municipalities
  - Object oriented at scale 1:500/1:1k
  - Covering the whole of the Netherlands from 2015

- **Key-register topography (BRT)**
  - Provided by Kadaster (National Mapping Agency)
  - Separate object oriented vector datasets at scale 1:10k, 1:100k, 1:250k, 1:500k and 1:1000k
  - Covering the whole of the Netherlands
Key-Registers of topography in the Netherlands

- **BGT:**
  - Large scale data for maintaining public areas
  - Municipalities are main users and producers

- **TOP10NL:**
  - Medium scale topographic data for visualization and GIS analyses
  - Produced by Kadaster
Key-Registers of topography in the Netherlands

- Example: Comparison of roads

TOP10NL roads shown transparently on top of BGT roads

Differences in the definition of road width
Key-registers of topography in the Netherlands

Motivation:

- ‘... Collect data once and use it many times’

- Can BRT 1:10k dataset (not per se TOP10NL) be automatically derived from BGT data?
Automatic Generalisation Procedure

BGT dataset

Reclassification & Selection

Generalization Operators

Spatial relationship (Topology)

Generalized BGT data

Topological Rules

Quality assessment

Aggregation

Elimination

Simplification

Collapse

BRT Model

kadaster
### Automatic Generalisation Procedure

#### Reclassification and Selection

<table>
<thead>
<tr>
<th>Class</th>
<th>BGT</th>
<th>TOP10NL</th>
</tr>
</thead>
<tbody>
<tr>
<td>(PartOfRoad (Wegdeel)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Terrain (Terrein)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>(part of)Water (Waterdeel)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>(PartOf)Railway (Spoorbaandeel)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Layout Element (Inrichtingselement)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Registration Area (Registratief Gebied)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Building (Pand)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Living Unit (Verblijfsobject)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Engineering Structure (Kunstwerk)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Building Complex (Gebouw)</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Geographical Area (Geografisch gebied)</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Functional Area (Functioneel gebied)</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Relief (Reliëf)</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Automatic Generalisation Procedure

- Geometric generalisation for specific classes

*Example: Buildings*

<table>
<thead>
<tr>
<th>Before generalization</th>
<th>After generalisation</th>
</tr>
</thead>
</table>

Conditions: If the distance between two buildings are closer than 3m then **amalgamate**. Keep the orthogonal shape and If the buildings are smaller than 25m² then **Remove**.
Automatic Generalisation Procedure

- Geometric generalisation for specific classes

*Example: Terrain*

<table>
<thead>
<tr>
<th>Before generalization</th>
<th>After generalisation</th>
</tr>
</thead>
</table>

Conditions: Terrain is **aggregated** (if they have the same attributes after reclassification) and **simplified**. Polygons smaller than 100m² are **removed**, as well as holes <100m². Boundaries are simplified.
Automatic Generalisation Procedure

- Geometric generalisation for specific classes
  
  *Example: Roads*

Eliminate road parts narrower than 2 meters?
Automatic Generalisation Procedure

- Geometric generalisation for specific classes

*Example: Roads*

Generalisation of roads based on calculated road widths

Medial Axis or Straight Skeleton algorithm
Automatic Generalisation Procedure

- Geometric generalisation for specific classes

  *Example: Roads*

  Generalisation of roads based on calculated road widths

  Medial Axis or Straight Skeleton algorithm
Automatic Generalisation Procedure

- Geometric generalisation for specific classes

*Example: Roads*

Original road feature, blue colored areas represent the areas under threshold.

Results of applying masking and erasing to the original road feature.
Automatic Generalisation Procedure

- **Spatial Relationship (Rules)**

  **Terrain**
  
  ‘Must not overlap with’: Building, Water and Road features

  **Building**
  
  ‘Must not overlap with’: Terrain, Water and Road features

  **Water**
  
  ‘Must not overlap with’: Terrain, Building and Road features

  **Road (side walk, highway, cycle path, parking lots)**
  
  ‘Must not overlap with’: each sub-road parts

* for each feature ‘must not have gaps’ also applied
Automatic Generalisation Procedure

- Spatial Relationship (Results)
Automatic Generalisation Procedure

- **Quality assessment**

  Difference between the intersected areas:

  $$R_{\text{Intrusion}} = \frac{\text{Area } (O \cap G)}{\text{Area } (O)}$$

  Difference between the intersected areas:

  $$R_{\text{Extrusion}} = \frac{\text{Area } (O \cap G)}{\text{Area } (G)}$$

  Ratio between areas:

  $$R_{\text{Area}} = \frac{\text{Area } (G)}{\text{Area } (O)}$$

  Positional deviation from polygon centroids:

  $$\overline{X} = \frac{\sum_{i=1}^{n} w_i x_i}{\sum_{i=1}^{n} w_i}$$

  $$\overline{Y} = \frac{\sum_{i=1}^{n} w_i y_i}{\sum_{i=1}^{n} w_i}$$
Automatic Generalisation Procedure

- **Results: quality assessment**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Intersection rate</th>
<th>Ratio</th>
<th>Average Euclidean distance(m)</th>
<th>Centroids deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Object Class</strong></td>
<td><strong>$R_{Intrusion}$</strong></td>
<td><strong>$R_{Ext}$</strong></td>
<td><strong>$R_{Area}$</strong></td>
<td></td>
</tr>
<tr>
<td>Building</td>
<td>0.98</td>
<td>0.97</td>
<td>1.01</td>
<td>0.42</td>
</tr>
<tr>
<td>Terrain</td>
<td>0.98</td>
<td>0.90</td>
<td>1.1</td>
<td>0.90</td>
</tr>
<tr>
<td>Sidewalk</td>
<td>0.46</td>
<td>0.49</td>
<td>0.94</td>
<td>0.62</td>
</tr>
<tr>
<td>Parking lot</td>
<td>0.91</td>
<td>0.48</td>
<td>6.47</td>
<td>0.77</td>
</tr>
</tbody>
</table>

The average of positional deviation: 0.67m
Automatic Generalisation Procedure

- Results: Before generalisation

- After generalisation
Concluding remarks and summary

- It is possible to automatically derive a data set at 1:10k from BGT data;
- Further research is required to define the optimal situation once BGT becomes practice:
  - Principle: Integration in one key register
  - One database with objects; smaller scales for visualisation; for some objects (road network, others?) also objects at smaller scales, not necessarily as part of topographic database
- Current TOP10NL users may (or should) move to BGT once BGT data is available (because of the history TOP10NL data has been available from 2006; while BGT data is still not)
Thank you for your attention!