Cache-friendly progressive data streaming with variable-scale data structures

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Introduction

• Part of PhD project
• Hierarchical model for 2D vector data: SSC / tGAP (not smooth!)
• 2D vector data and level of detail in one model
• Haunert et al. (2009) proposed theory for progressive transmission
• Does it work in practice?
Context – Hierarchical model

- Start: area partition
- Process of merging/splitting objects, until only one object is left
- This process generates hierarchy (DAG)
- 2 questions:
  1. Which object as candidate for merge/split?
  2. Which neighbour(s) to merge (parts of) candidate object to?
Context – Hierarchical model

- Lifespan for each primitive (edges and faces), in the scale dimension
- Map varies with scale, going up in cube: *vario-scale*
Context – Hierarchical model

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Structures for storing SSC

- Possible encoding of cube: tGAP - topological Generalized Area Partitioning
- Store information on area objects
- Use topology, no explicit geometry for area objects, but:
  1. Edge: polyline with pointers to neighbours, plus bbox
  2. Face: Area extent — bbox, plus point (convenient)
Making a map
Making a map

- with real data
Making a map

- with real data
Making a map

- with real data
‘Progressive slices’
‘Progressive slices’

- with real data
‘Progressive slices’

- with real data
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‘Progressive slices’

- with real data
Pipeline

Base data
- Tables:
  - node
  - edge
  - face

1. tGAP compiler
   Operations:
   - merge
   - split
   - simplify

2. tGAP data
   Tables:
   - node
   - edge
   - face
   + imp

3. Network

4. TopoMapUpdater
   + at imp
   + faces
   + edges

5. TopoMap

6. DisplayList Cache

7. Visualizer

8. Polygon DisplayList Cache

9. Visualizer
Incremental updates (over the network)
Incremental updates (over the network)
Incremental updates (over the network)
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Incremental updates (over the network)
## Size (compared to most detailed map)

<table>
<thead>
<tr>
<th>Dataset + type of data</th>
<th>Size map (kB)</th>
<th>Size Progressive (kB)</th>
<th>Increase (factor)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hamburg (rural)</td>
<td>477</td>
<td>822</td>
<td>1.72×</td>
</tr>
<tr>
<td>Colchester (rural)</td>
<td>3 377</td>
<td>5 366</td>
<td>1.59×</td>
</tr>
<tr>
<td>Buchholz (rural)</td>
<td>5 044</td>
<td>8 597</td>
<td>1.70×</td>
</tr>
<tr>
<td>Delft (urban)</td>
<td>8 369</td>
<td>13 802</td>
<td>1.65×</td>
</tr>
</tbody>
</table>

Note: edges simplified!
Demo
Demo
Demo
Demo
Demo
Field tree

- Missing: Link between users path and data retrieval
- Super-impose ‘regular’ structure in SSC, Fieldtree (Frank and Barrera, 1990)
Field tree
Field tree

- Use it in generalisation process
- Perform progressive transfer for Fields
Field tree
Field tree
Field tree
Field tree

- Fixed boundaries: trouble? Resolved at next level?
- How to deal with retrieval (shared)? Mapping Faces (point in side) 1:1 Fields?
- What’s an optimal size for Fields?
- Divide-and-conquer: parallel build
Thank you for your attention

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References
