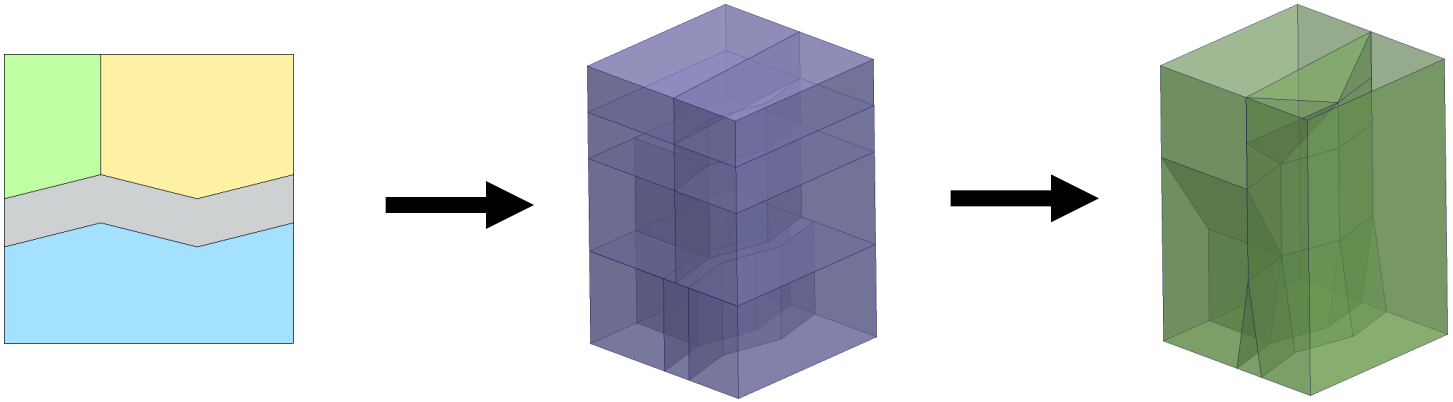


Towards a true vario-scale structure supporting smooth-zoom

18-7-2011

Peter van Oosterom and Martijn Meijers
(patent pending nr. OCNL 2006630
prepared by Dirk de Jong, European Patent Attorney, Vereenigde)

Contents

- Introduction
- tGAP example
- Smooth tGAP → SSC
- Creating SSC
- Using SSC
- Conclusion

This is not 'yet another tGAP story'…
(generalized area partitioning)
Because… SSC, space-scale cube

Early use of additional dimension for scale (importance) representation

- Alternative Reactive-tree (van Oosterom, Auto-Carto 10, 1991)

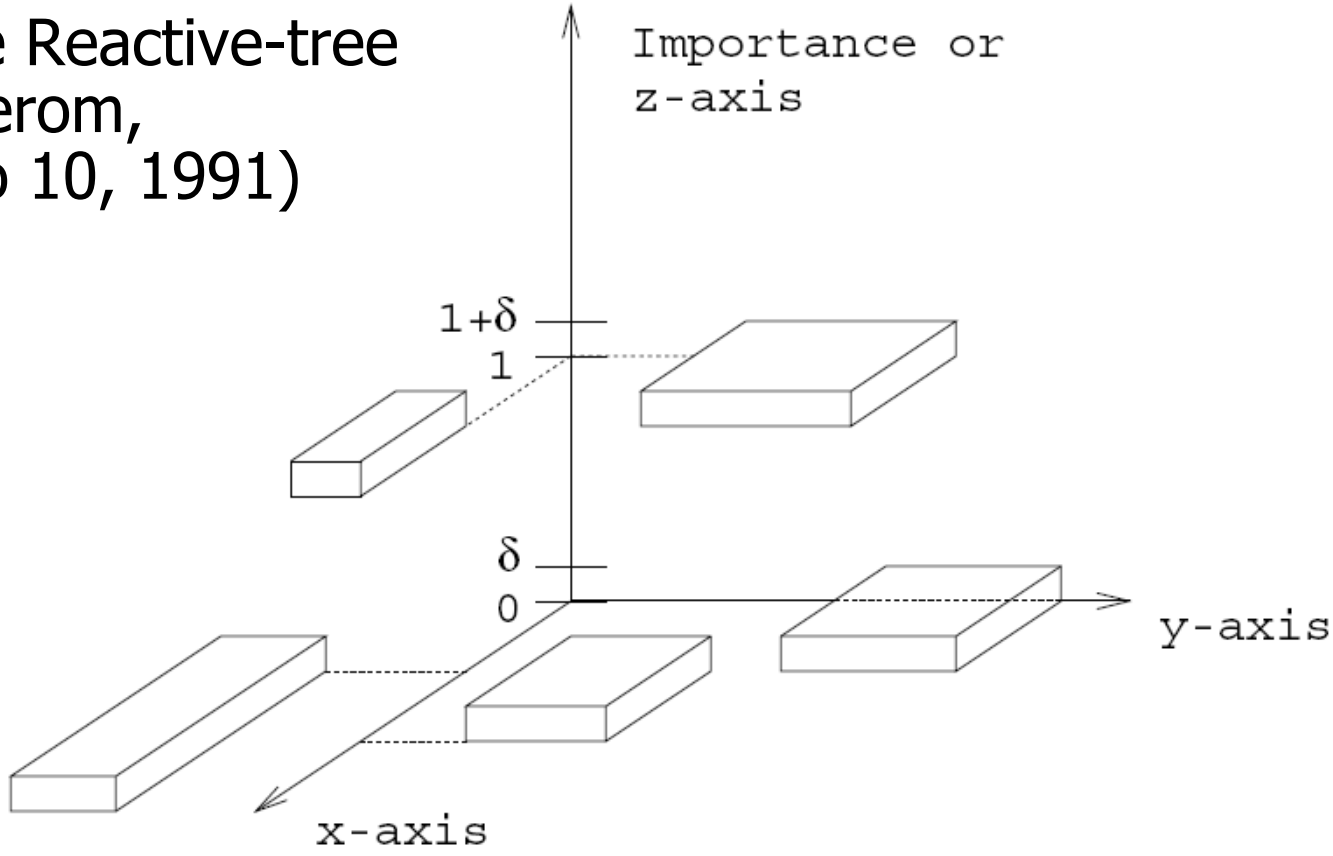
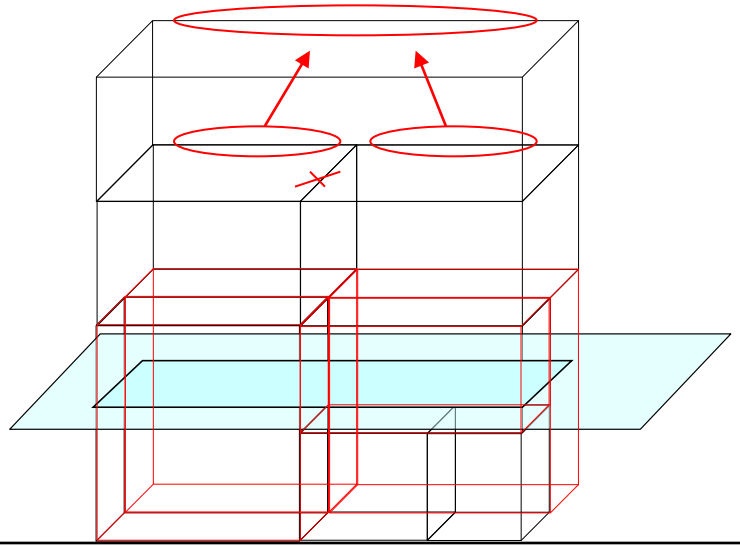


Figure 8: The 3D MBRs of the Alternative Reactive-tree

Generalized Area Partitioning-tree (GAP-tree) history

- Normal GAP-tree (van Oosterom 1993) areas are stored as independent polygons → computed redundancy (both at given scales and between scales)

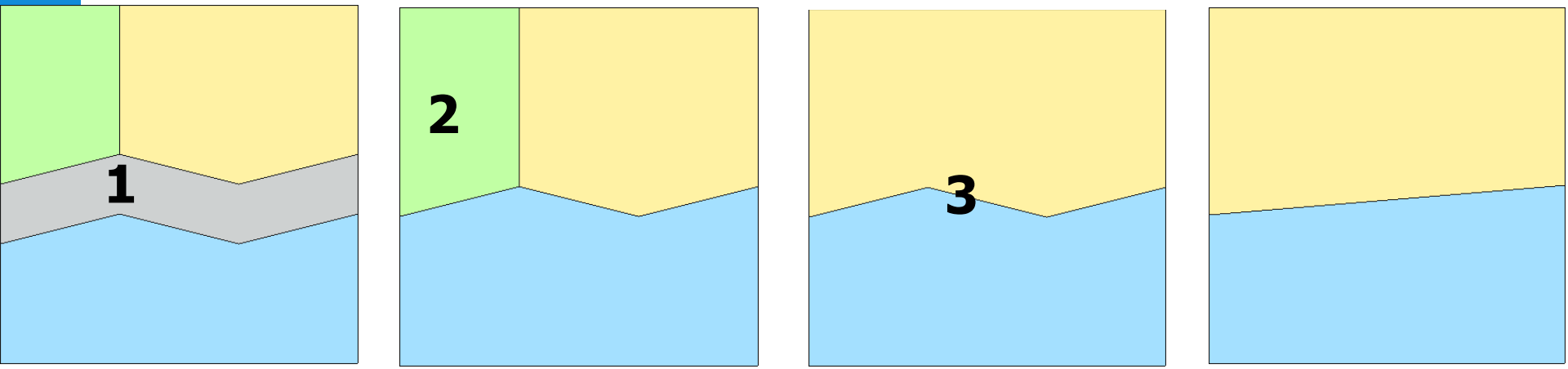
- Vermeij et al. 2003 proposed topological GAP-tree: edges and faces (with importance range, consider as height), reduced redundancy between neighbors → scale/imp with 3D prisms



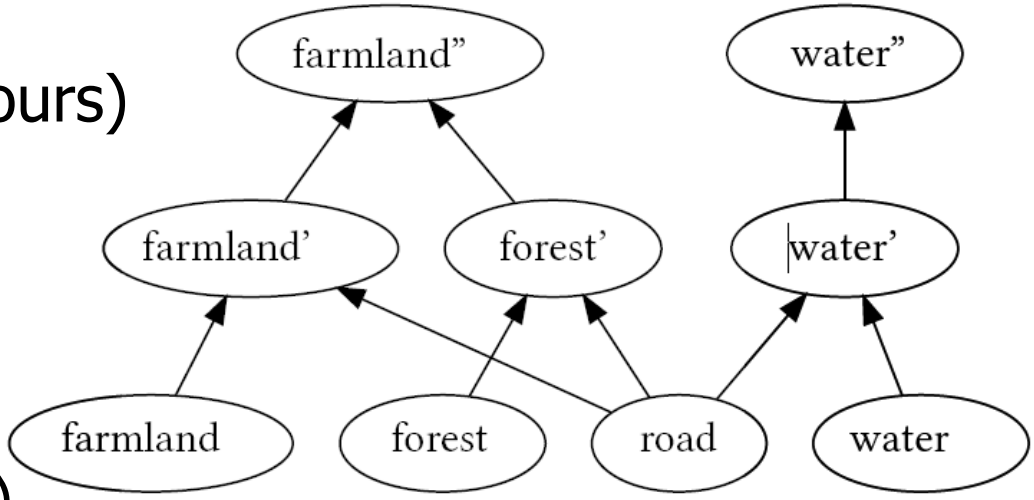
Contents

- Introduction
- tGAP example
- Smooth tGAP → SSC
- Creating SSC
- Using SSC
- Conclusion

tGAP example

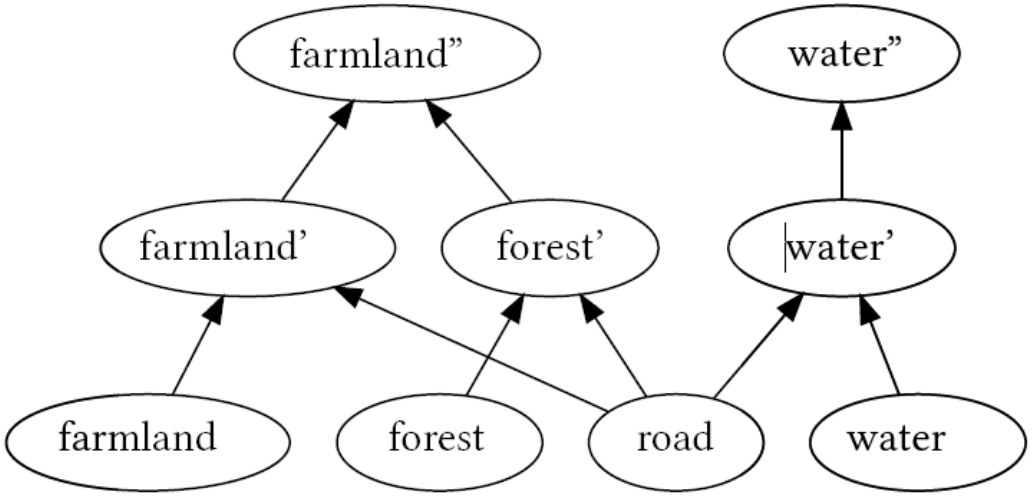


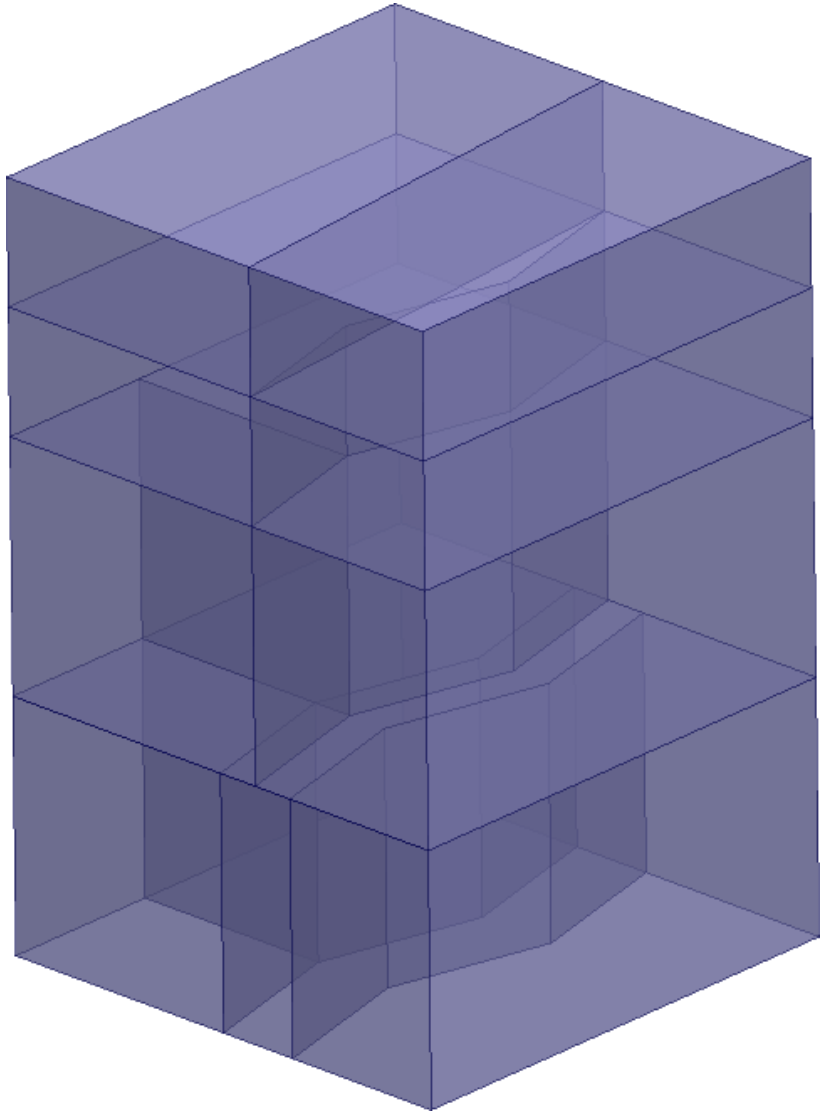
1. Collapse road
   (split area, merge neighbours)
2. Delete forest
   (merge with farmland)
3. Simplify boundary
   (between water/farmland)



2D+scale → 3D integrated

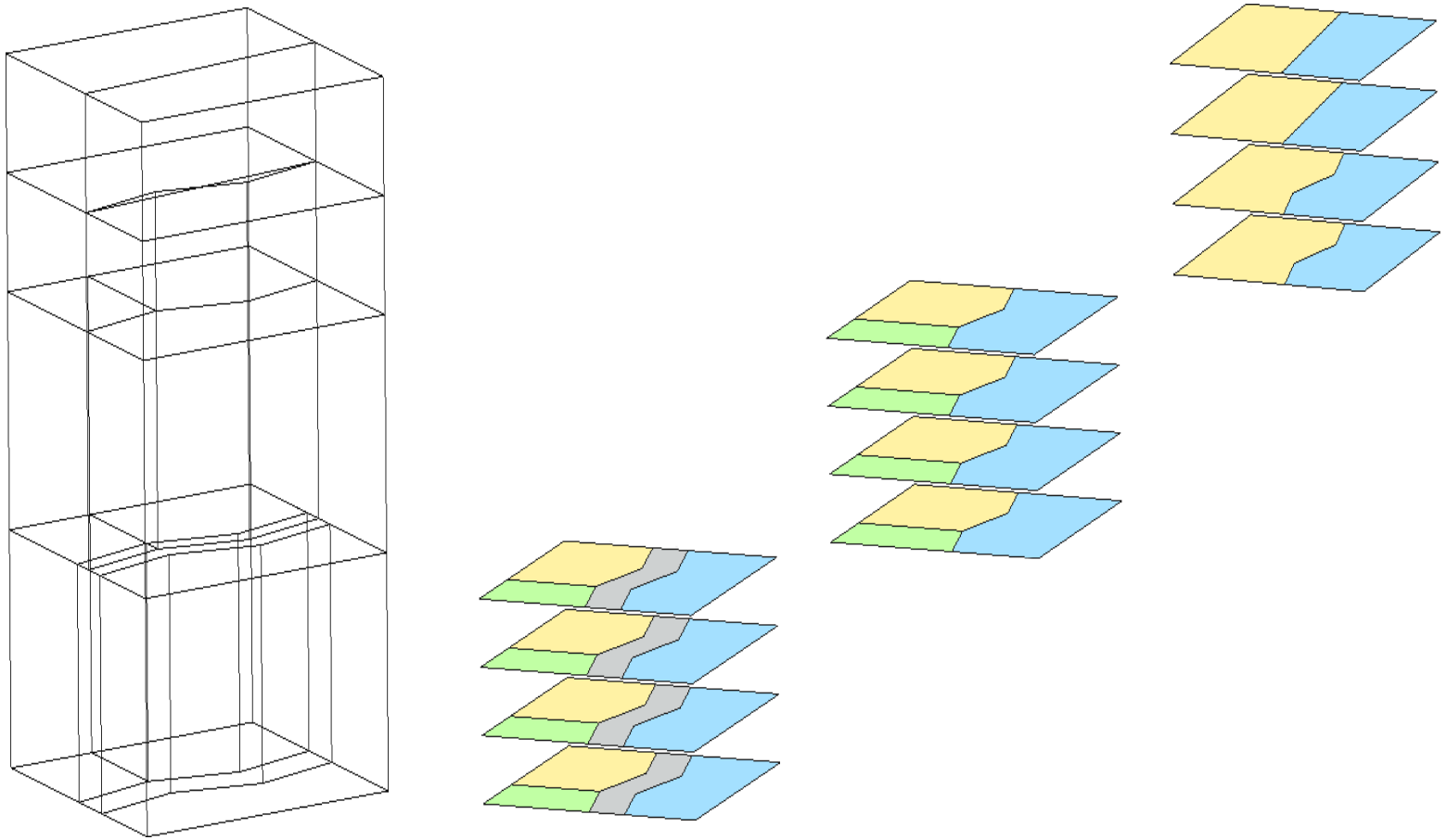
- tGAP DAG to 3D structure
- Parent-child:
  →neighbour above-below





Delta scale

→ no change at all or local shock

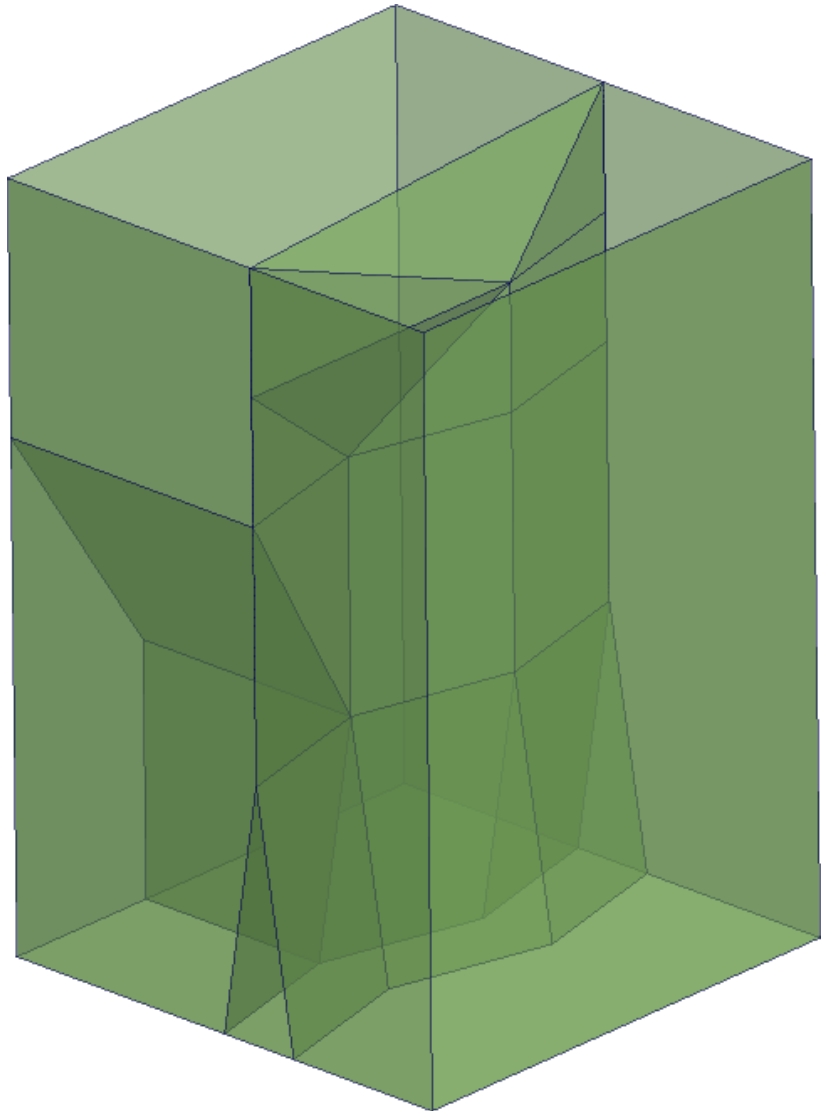


Contents

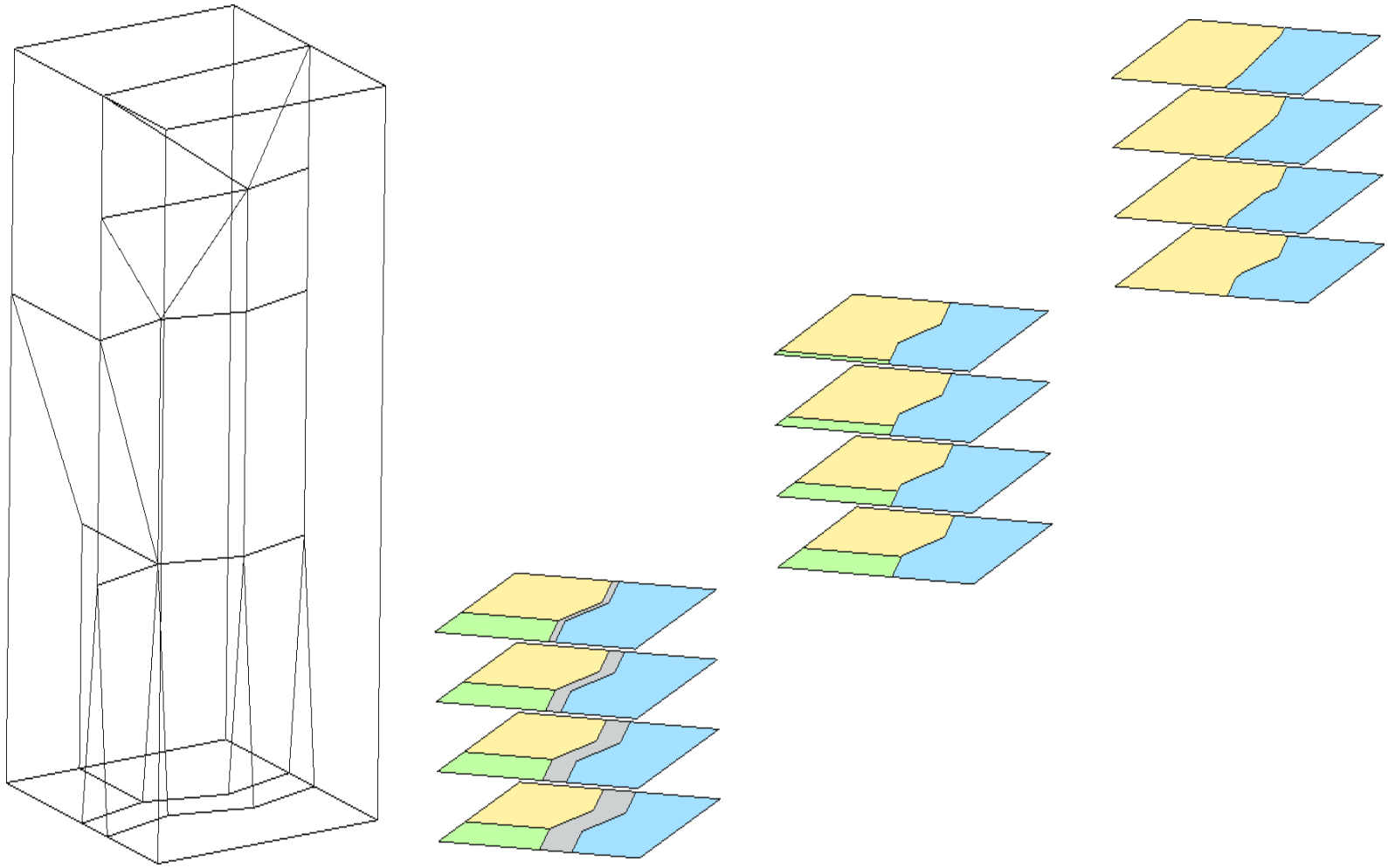
- Introduction
- tGAP example
- Smooth tGAP → SSC
- Creating SSC
- Using SSC
- Conclusion

Smooth tGAP

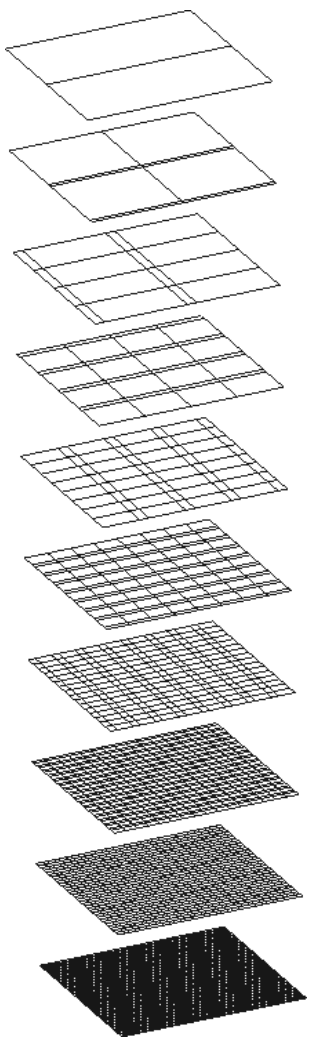
- Remove local shock
  → no horizontal faces
- Gradual changes
  → less vertical faces
- Resulting polyhedron
  → representation of single object for all its scales

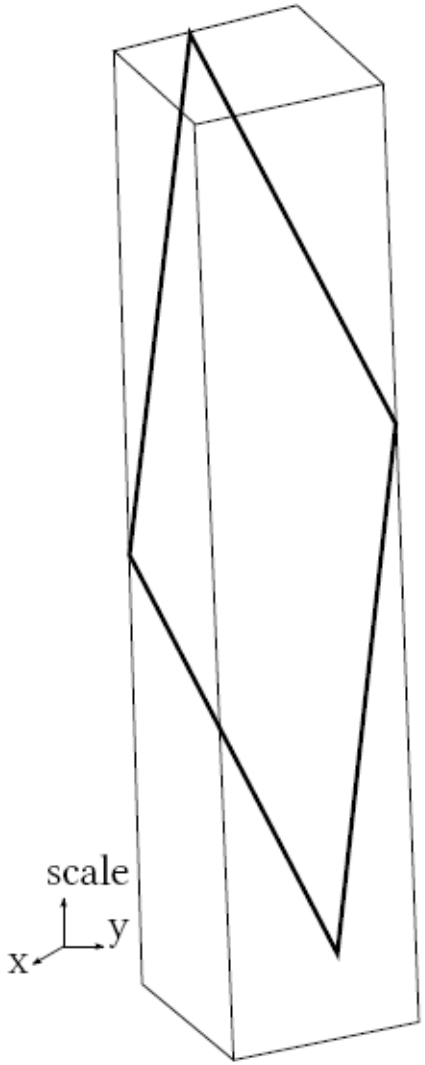


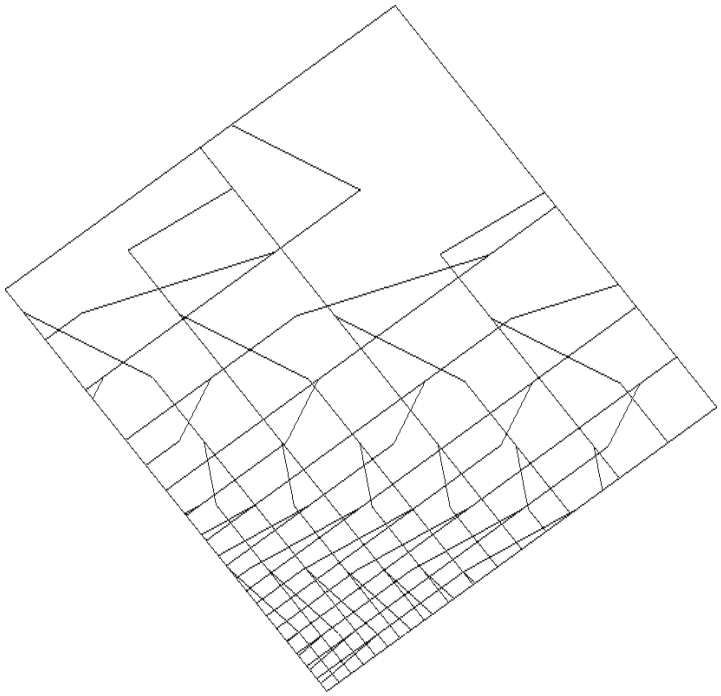
Delta scale → delta map



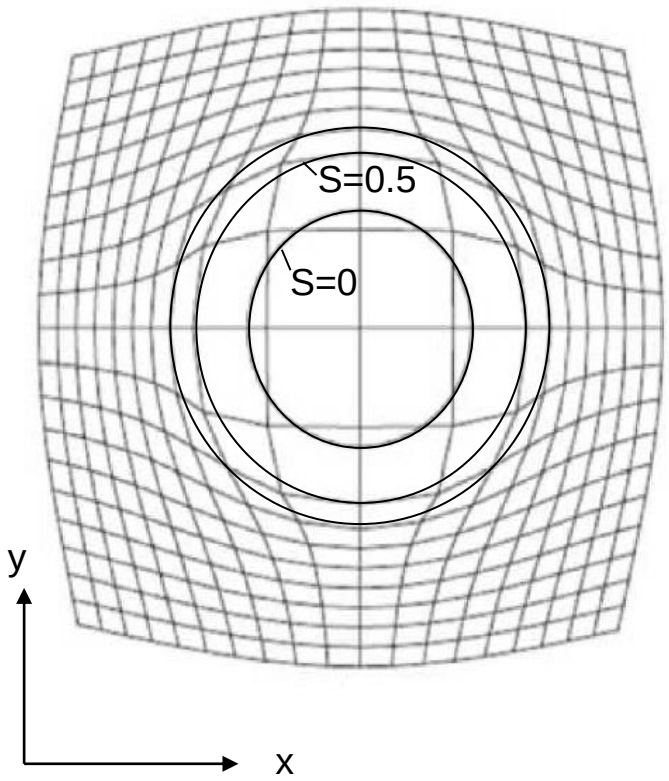
Non-horizontal slice → mixed scale map

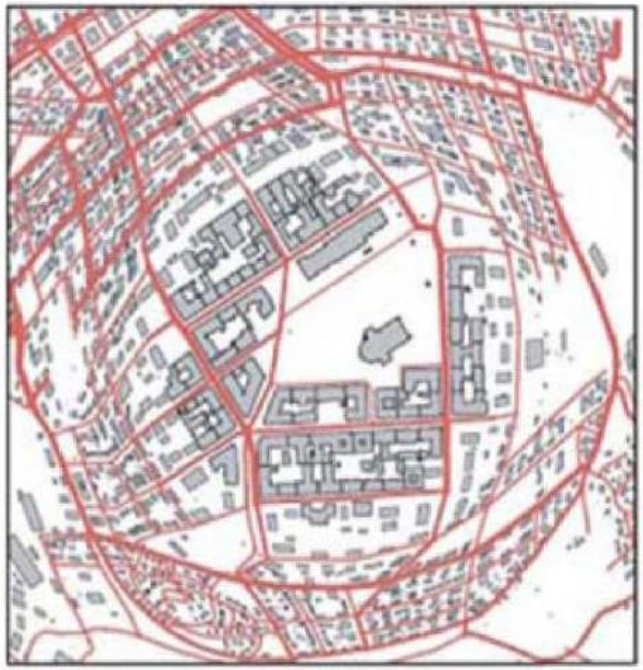






Non-flat slice → mixed scale map (fish-eye example)





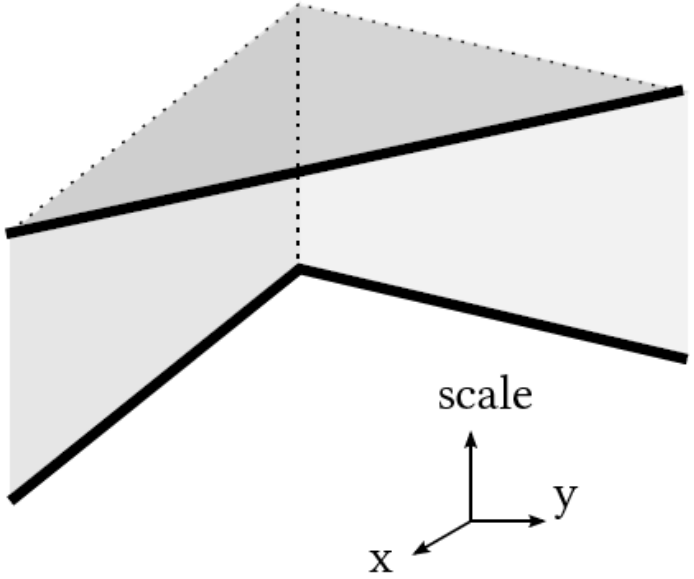
source: Harrie et al, 2002, ISPRS Archives 34(4):237–242

Contents

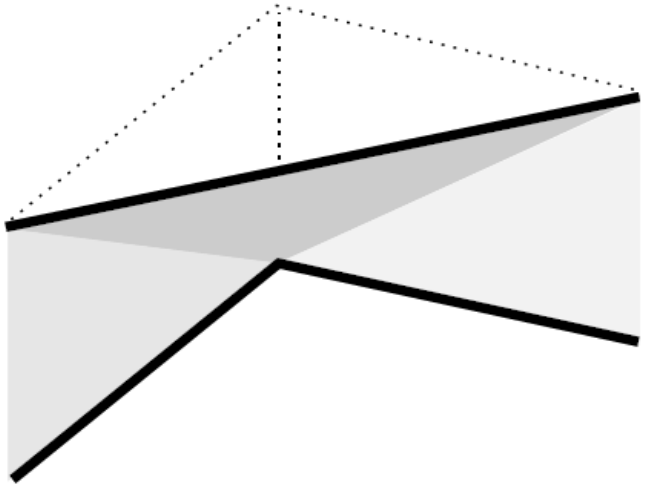
- Introduction
- tGAP example
- Smooth tGAP → SSC
- Creating SSC
- Using SSC
- Conclusion

Smooth simplify

- Shock change:
  - 2 rectangles
  - 1 triangle

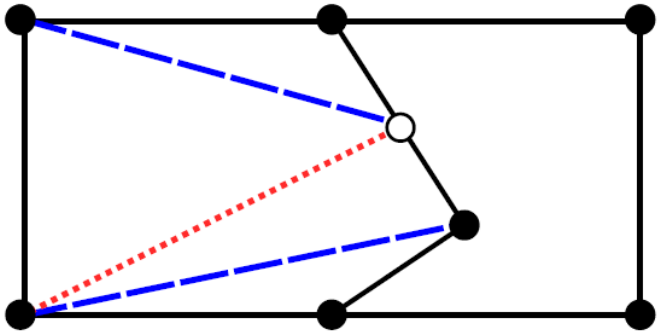


- Smooth change:
  - 3 triangles

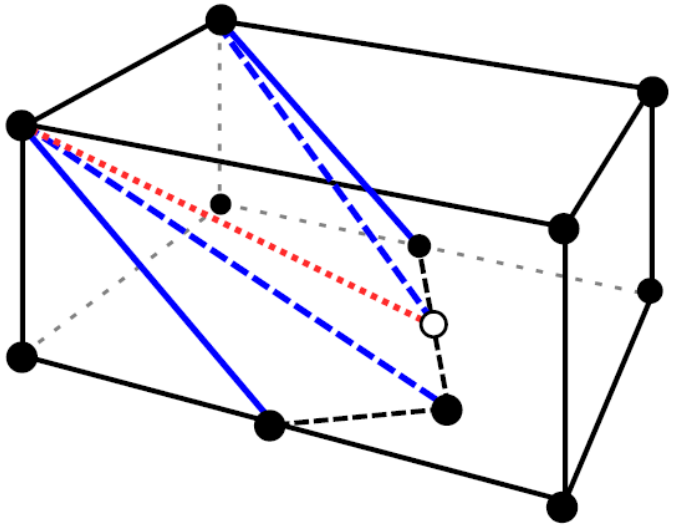


Smooth merge for convex neighbour

1. make #nodes shared and target bnd equal (n)
2. connect node pairs
3. 2 triangles + n-3 quadrangles
4. if non-flat → split quadrangle into 2 triangle
5. Merge planar neighbours



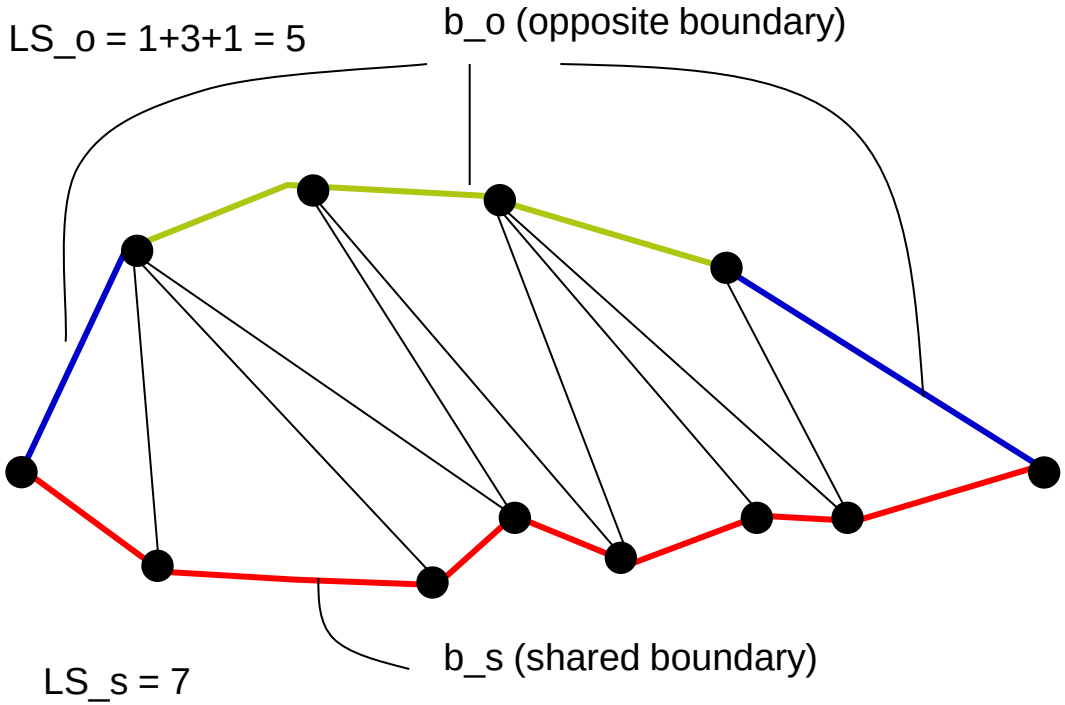
top view

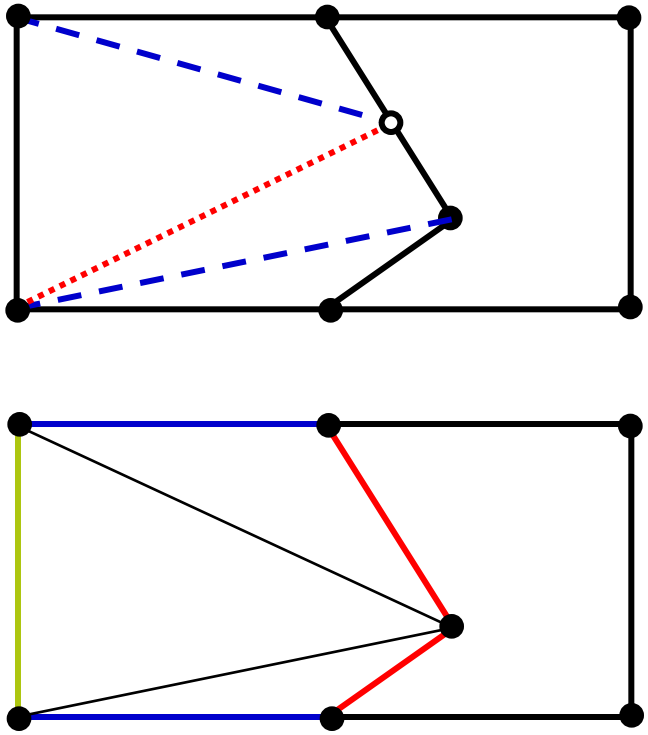


space-scale view

Alternative (without adding nodes)

Create triangle base at one side
and top at other side

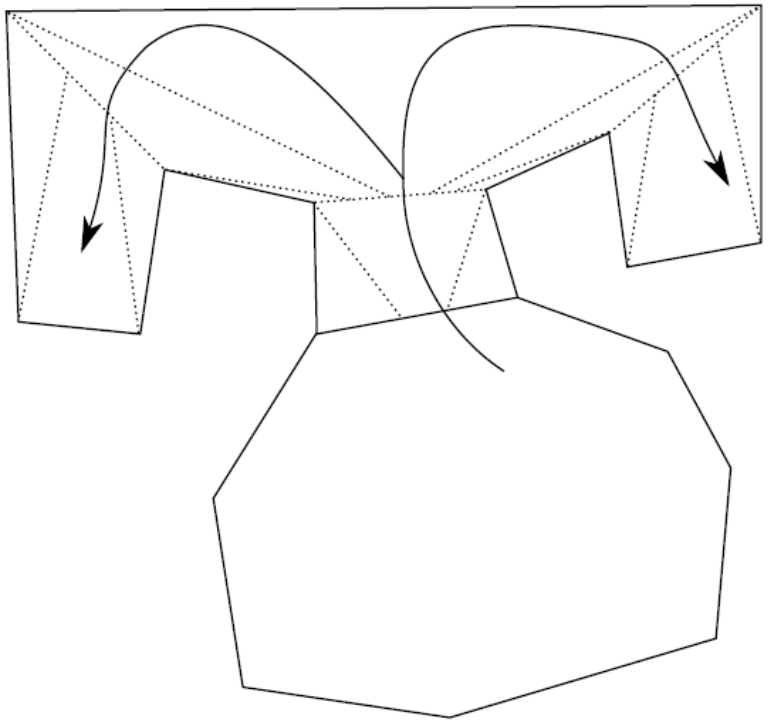




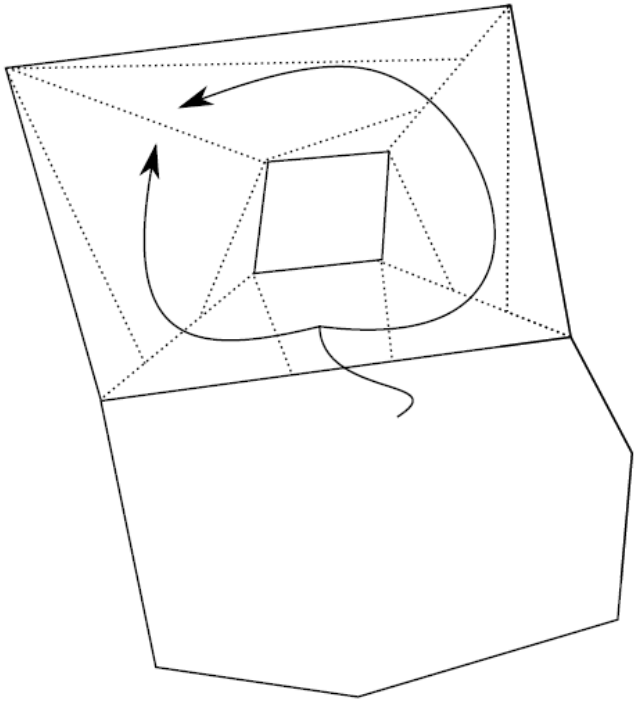
at scale s2, from s1 to s2, at scale s1

Non-convex neighbour
→ subdivide in convex parts

m-shaped neighbour



neighbour with hole



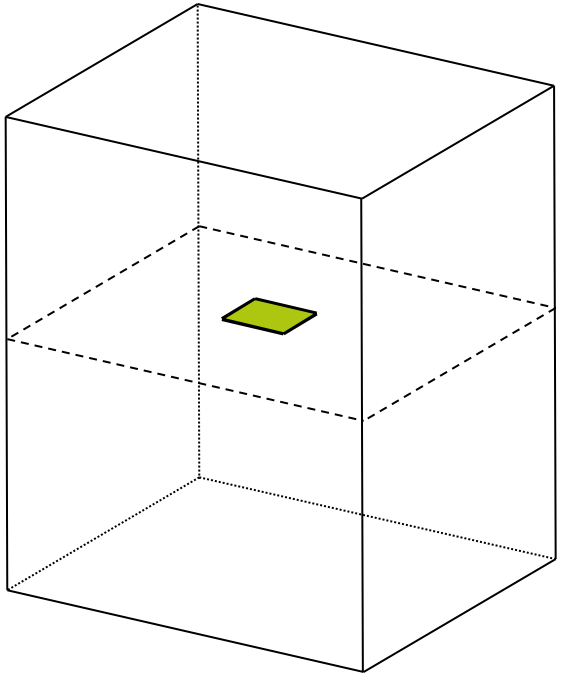
(note: smooth collapse/split similar to smooth merge)

Contents

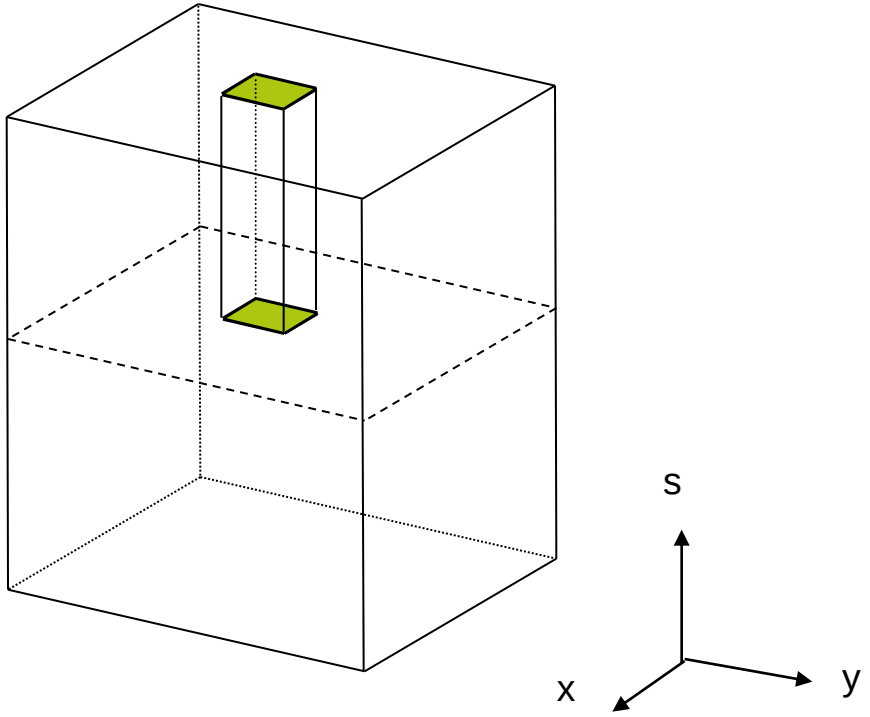
- Introduction
- tGAP example
- Smooth tGAP → SSC
- Creating SSC
- Using SSC
- Conclusion

Selection based on (n+1)D overlap from space-scale cube

Simple initial map

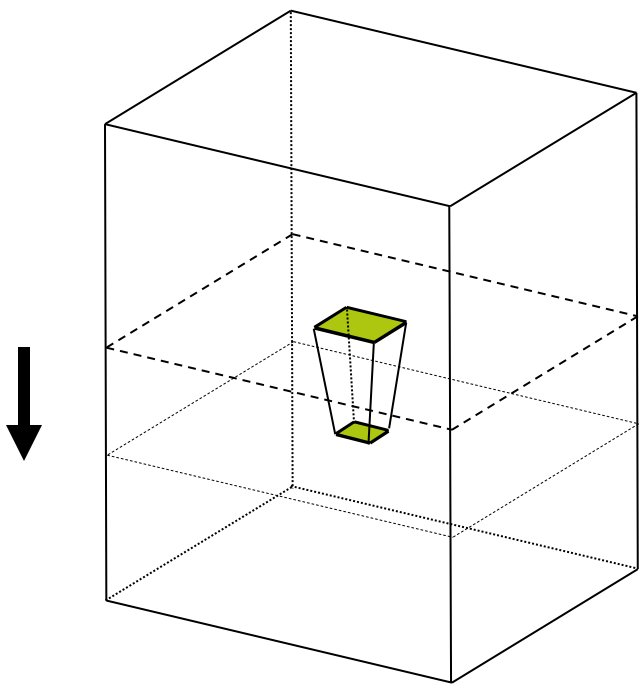


Progressive initial map
(sorting lower→higher detail)

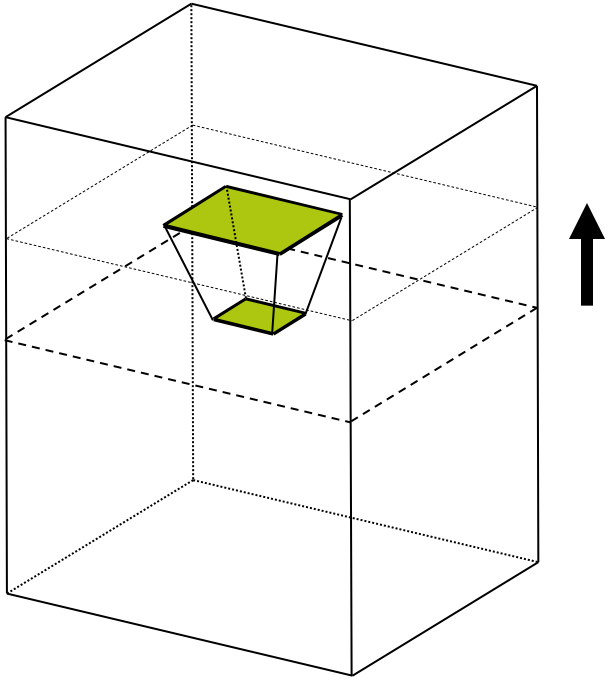


(n+1)D overlap selection for zooming

Progressive zoom-in
(normal sorting order)

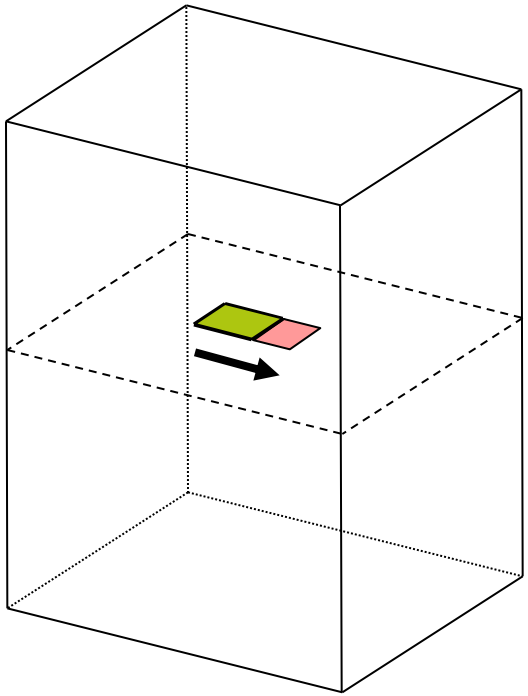


Progressive zoom-out
(reverse sorting order)

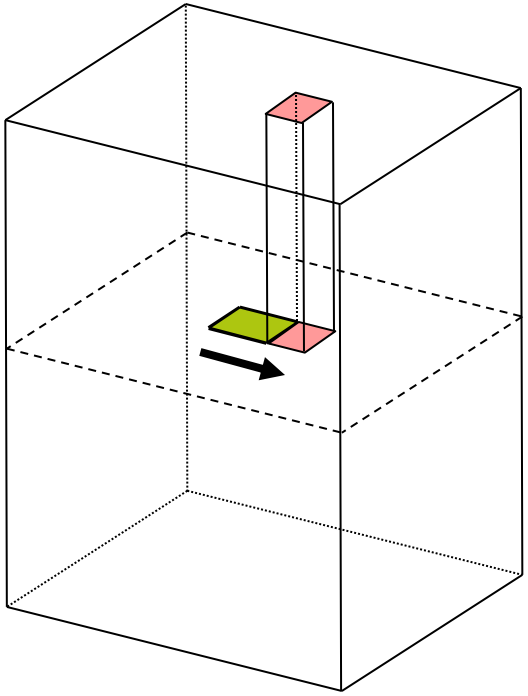


(n+1)D overlap selection for panning

Normal panning



Progressive panning
(normal sorting order)



Contents

- Introduction
- tGAP example
- Smooth tGAP → SSC
- Creating SSC
- Using SSC
- Conclusion

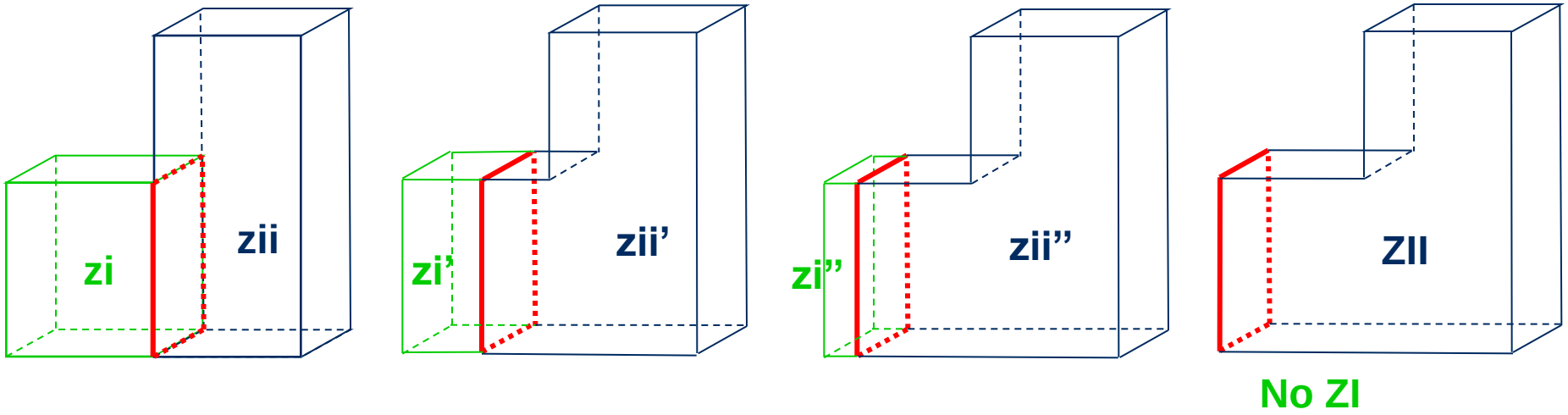
Some future work

- Semantic aspect (incl. attributes) needs further attention
- Lower dimension primitives (lines, points) do also fit in the structure, but need further investigations
- Not per se object by object creation (but multiple objects in parallel → see paper)
- Sliver before disappearing
- Lot of implementing and testing needed

Conclusions, true vario-scale

- tGAP is well suited for web environment (progressive)
- True vario-scale nD maps based on (n+1)D representations and slicing (selecting) with hyperplanes:
  - tGAP structure translates 2D space and 1D scale in an integrated 3D topological representation: no overlaps and no gaps (in space and scale)
  - Starting with 3D space and adding scale results in 4D
  - Starting with 3D space and time (history) and adding scale results in 5D topological structure (again no gaps/overlaps in space, time or scale), well defined neighbors in space, time and scale directions

3D smooth merge
(more details in patent claim)

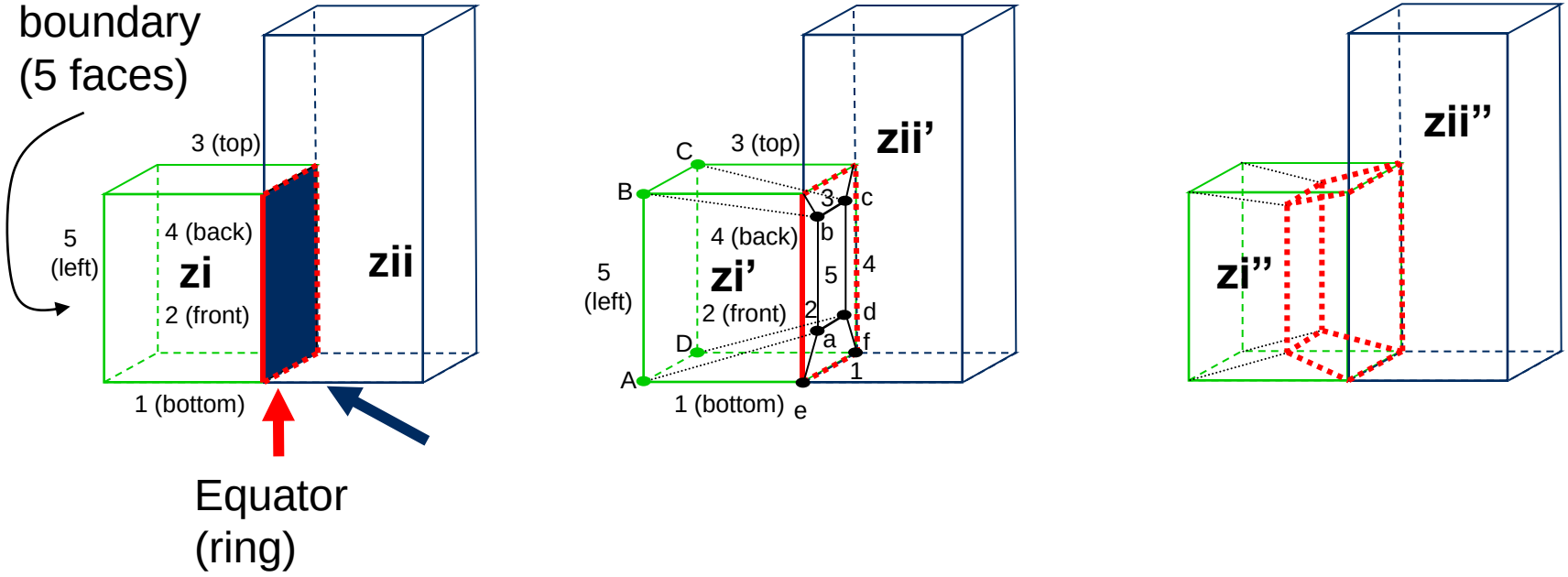


Generic 3D smooth merge

High detail

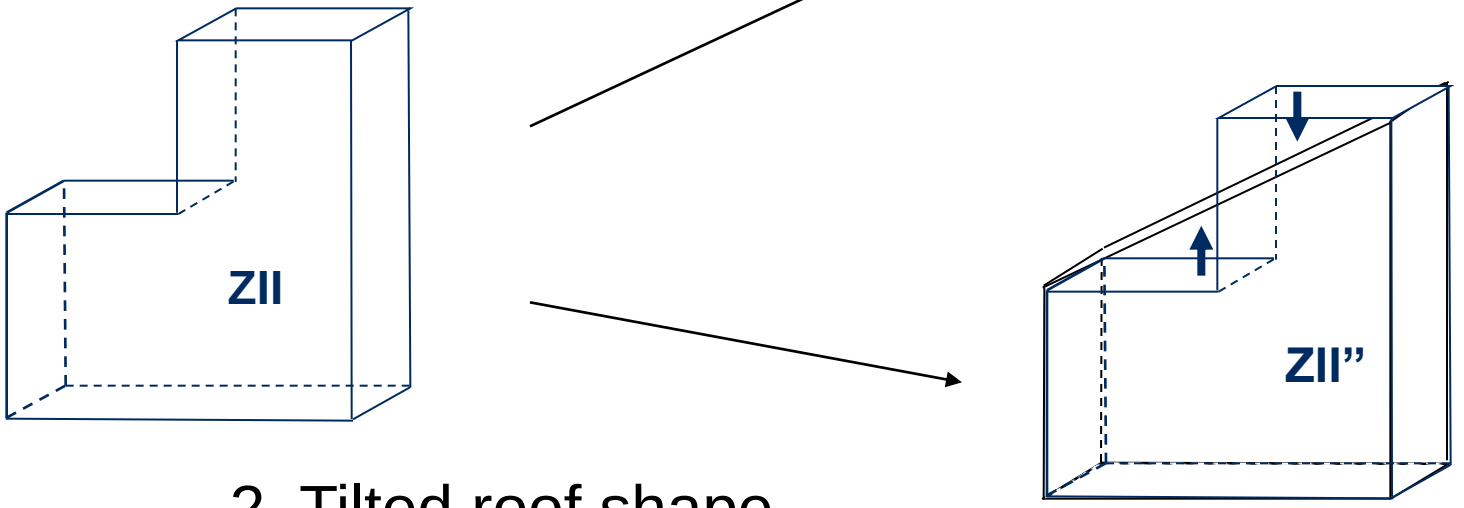
Low detail

Opposite boundary (5 faces)



3D Smooth simplify

Simplify boundary of merged object, two options:



Pseudo 4D-view

Zone zi shown for reference purpose