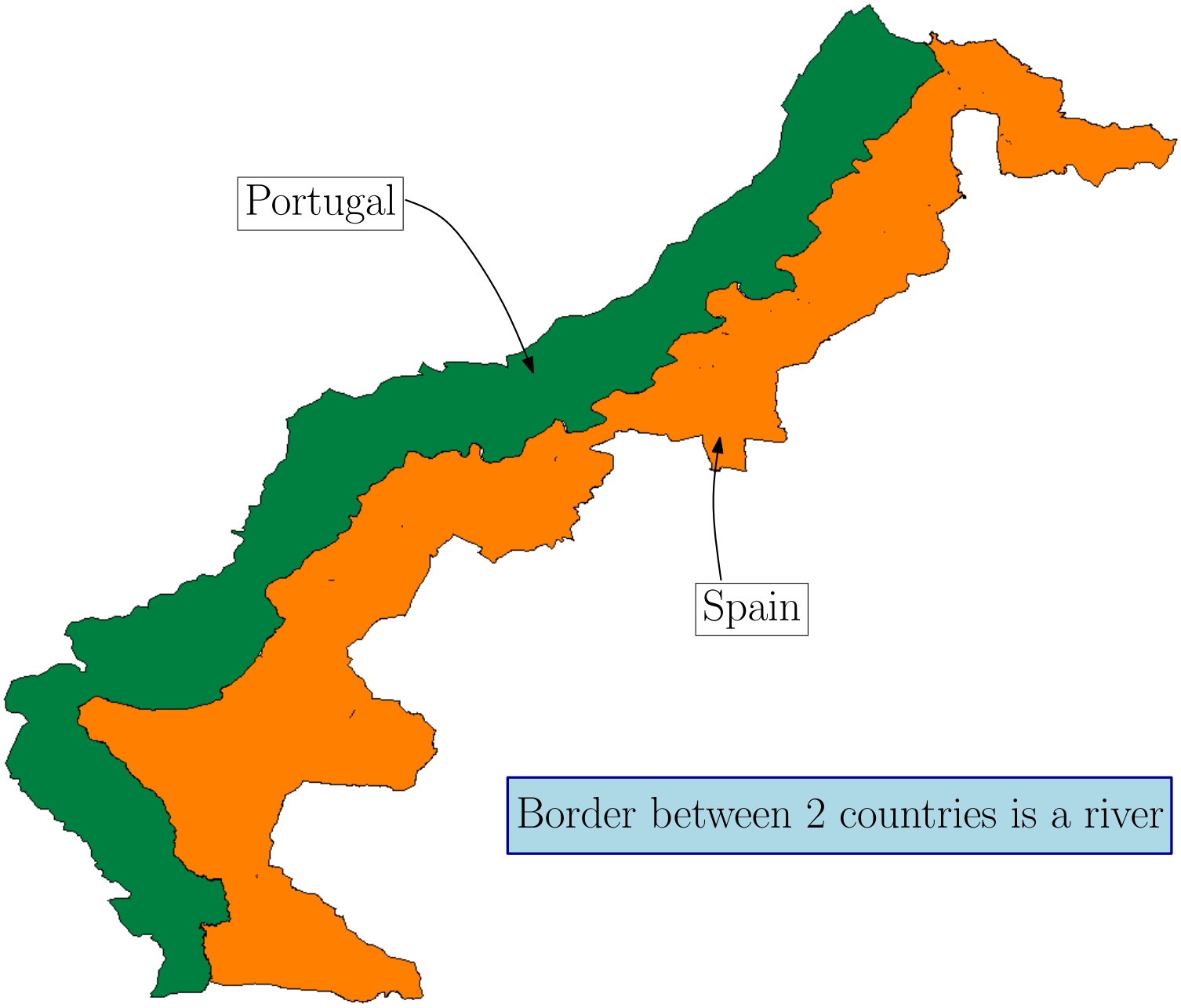
Edge-matching polygons with a constrained triangulation

Hugo Ledoux Ken Arroyo Ohori

Technische Universiteit Delft

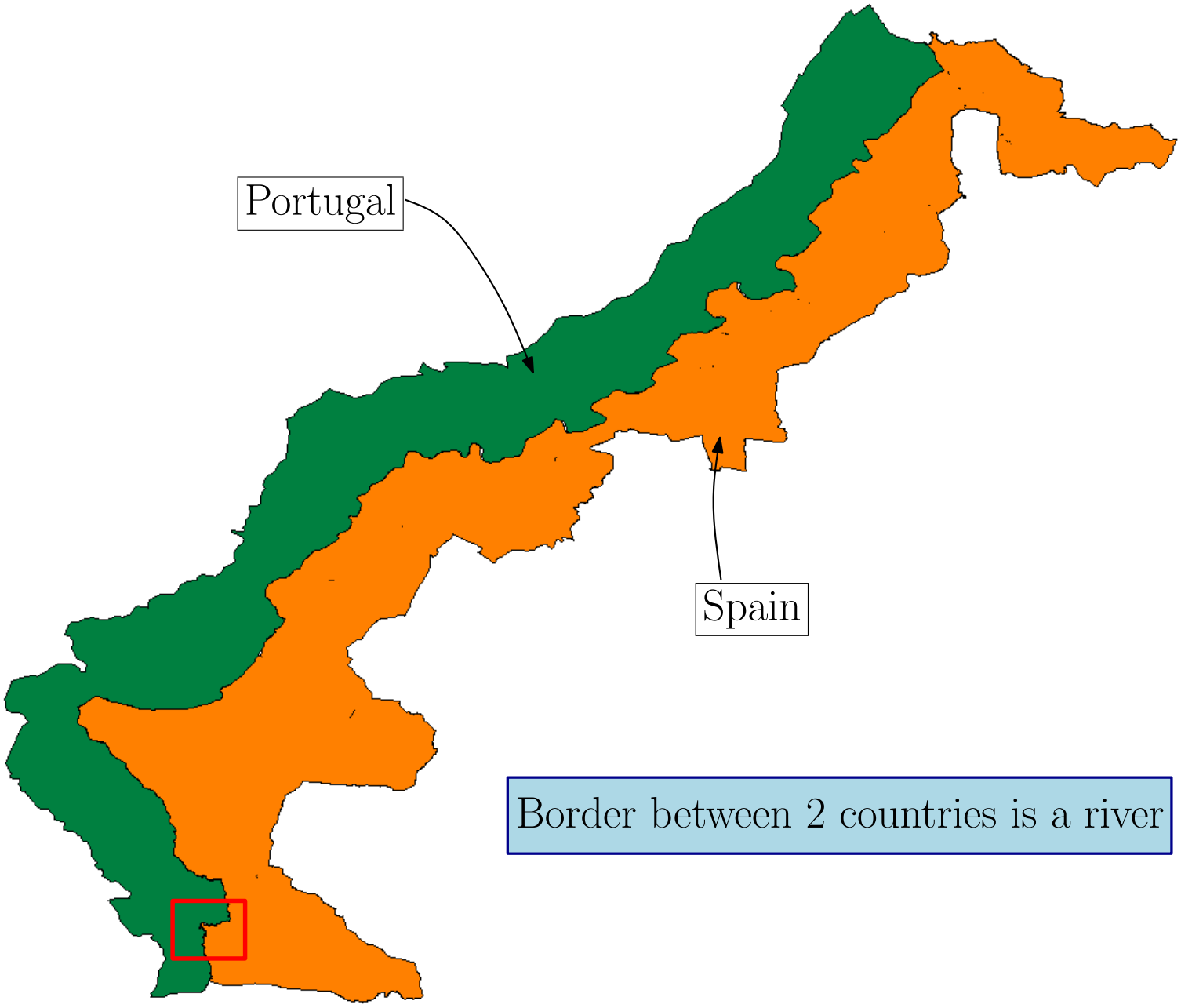
2011/01/26
GIS Ostrava 2011, Czech Republic

Edge matching: ensuring the border is coherent



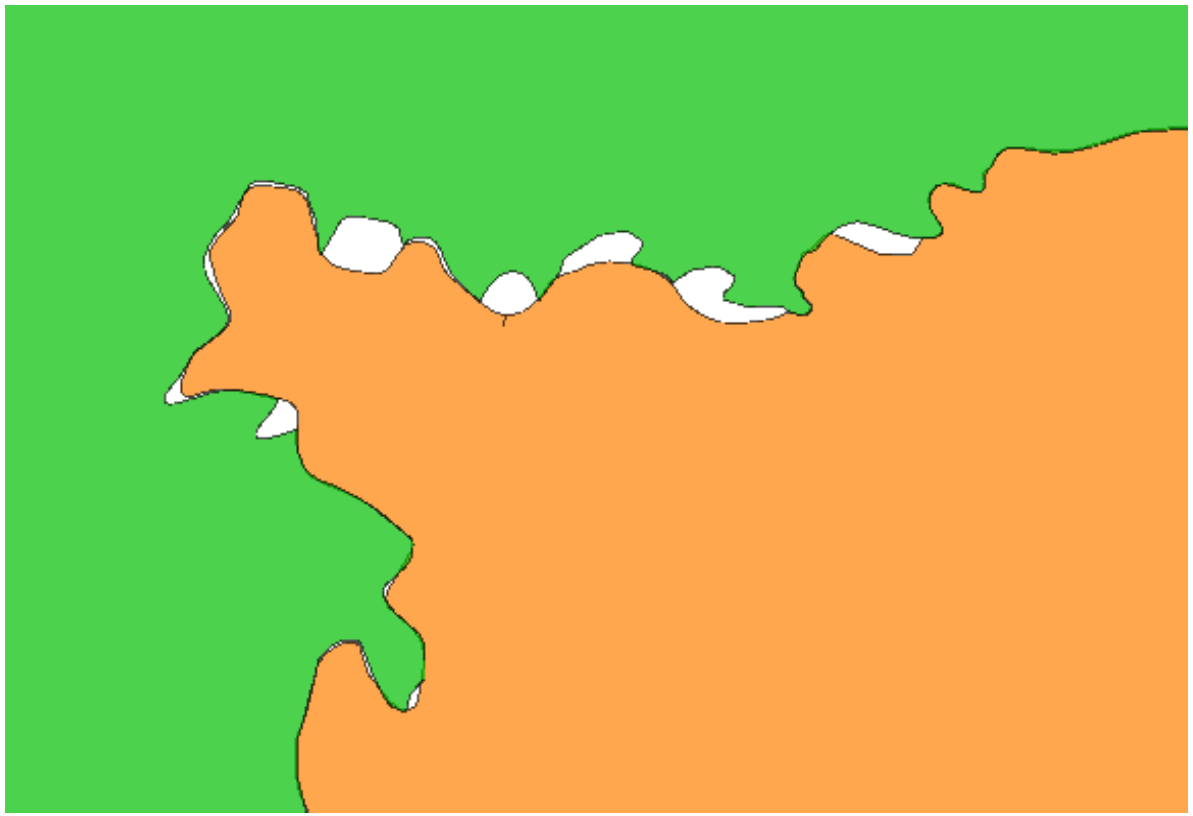
Border between 2 countries is a river

Edge matching: ensuring the border is coherent



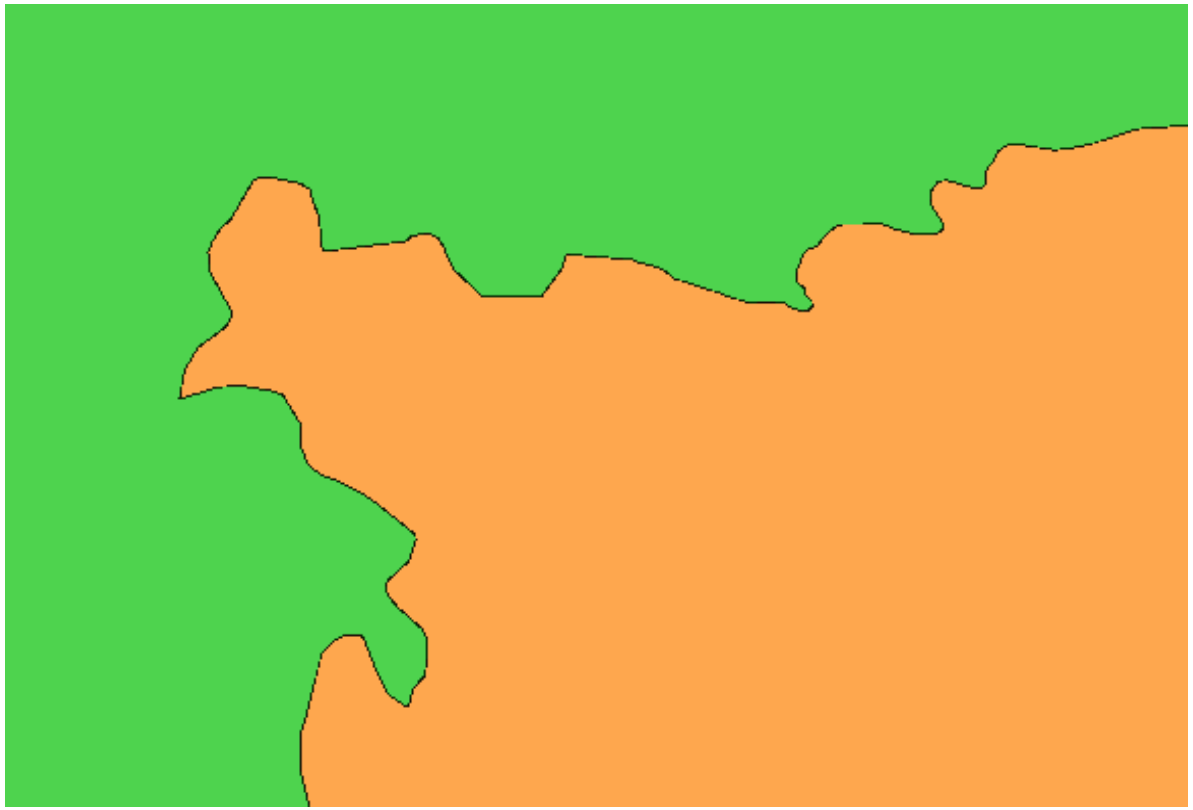
Border between 2 countries is a river

Often the polygons do not "match"



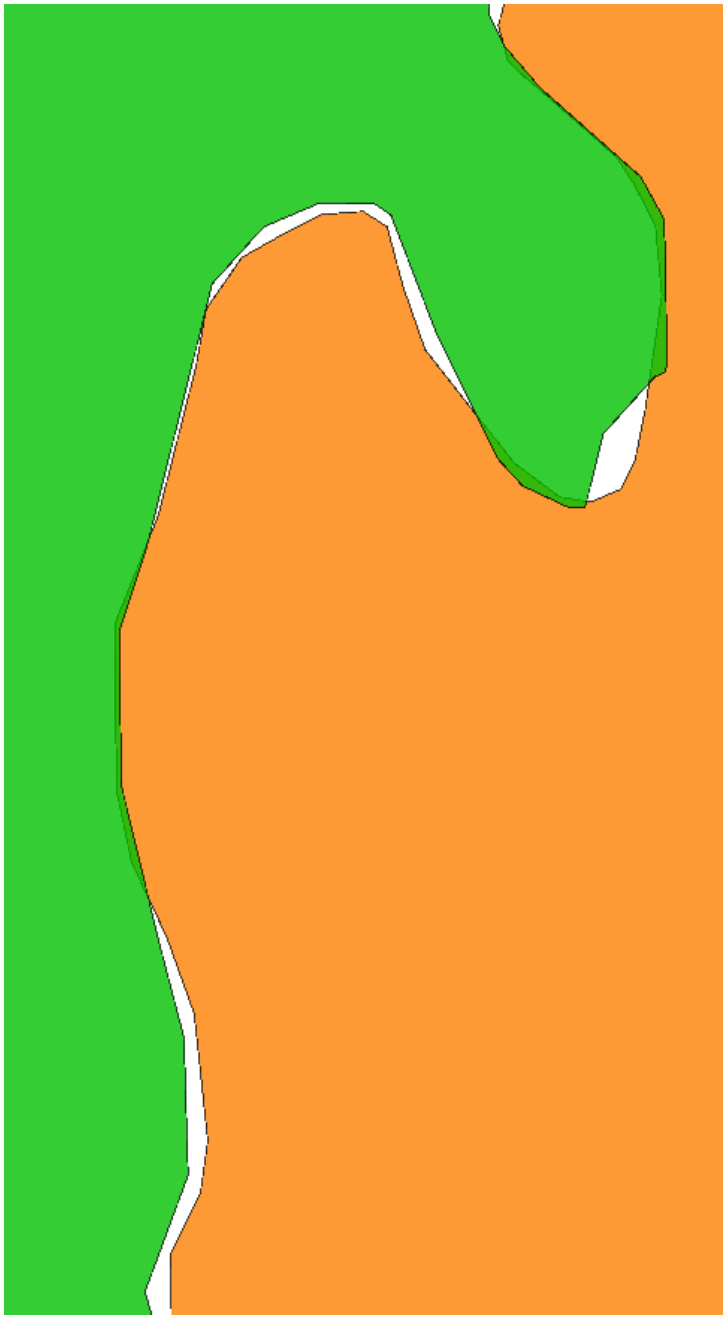
1. Diff instruments to collect data
2. Diff scales
3. Diff coordinate reference systems

Often the polygons do not "match"



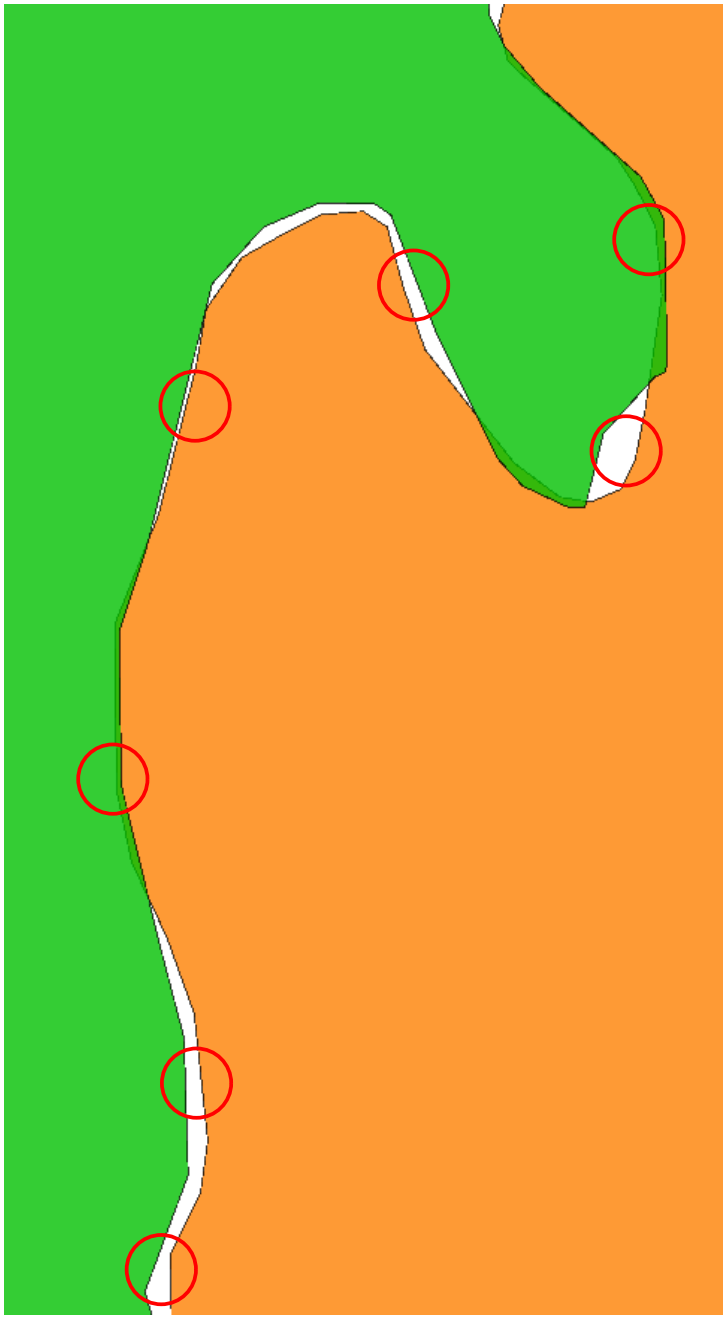
1. Diff instruments to collect data
2. Diff scales
3. Diff coordinate reference systems

How edge matching is usually done: snapping



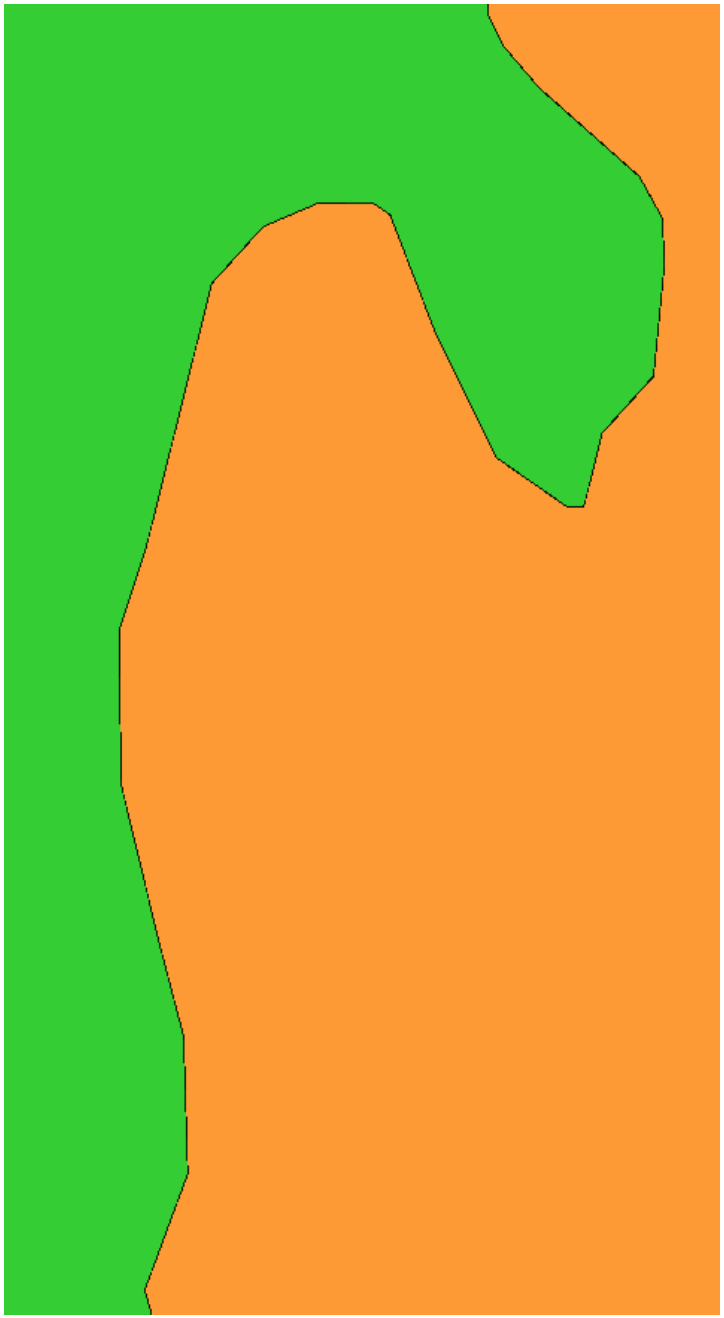
- Tolerance (*threshold*) is used for *snapping* vertices
- Tolerance based on scale of datasets
- Works fine for *simple* problems

How edge matching is usually done: snapping



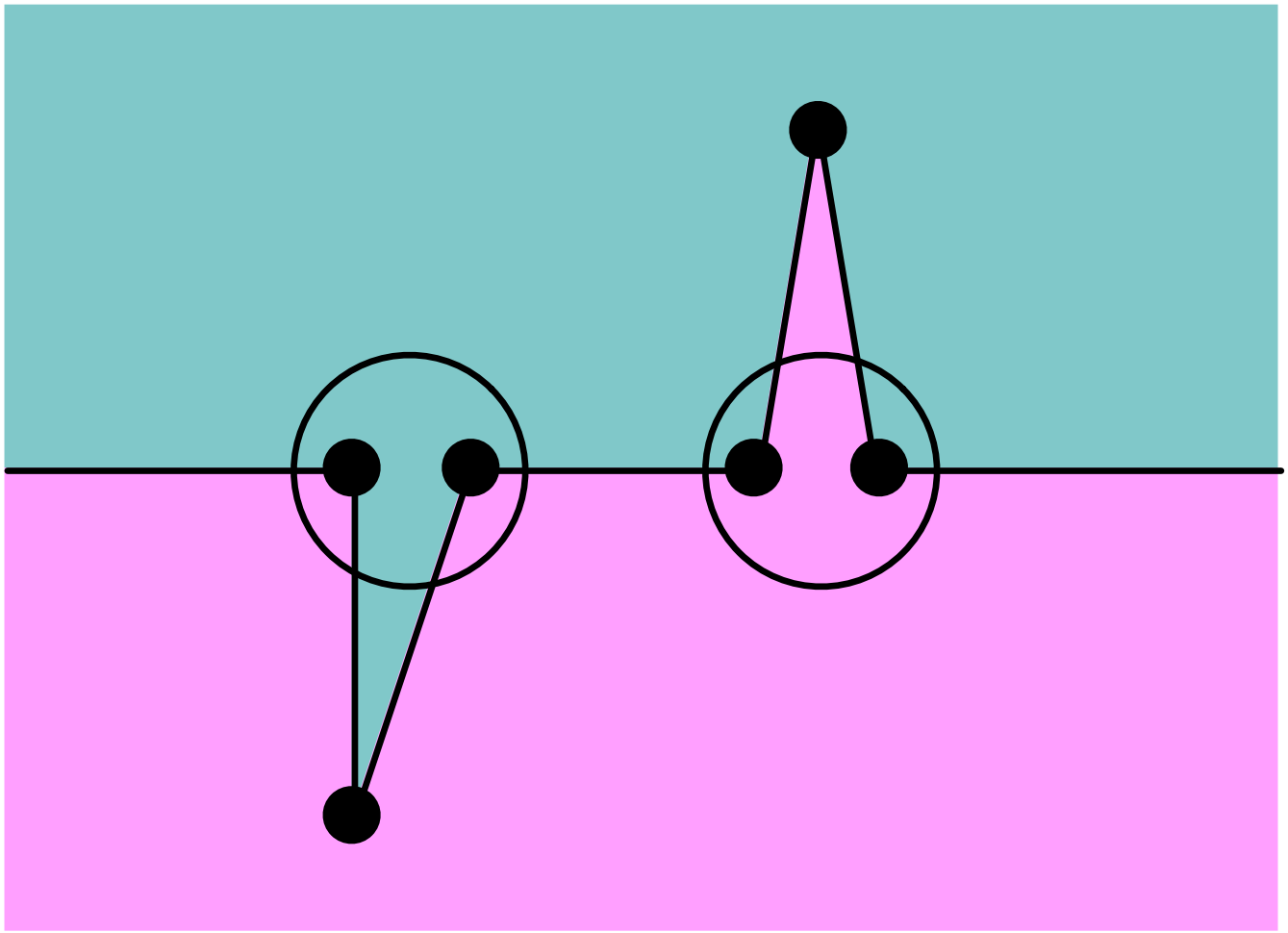
- Tolerance (*threshold*) is used for *snapping* vertices
- Tolerance based on scale of datasets
- Works fine for *simple* problems

How edge matching is usually done: snapping



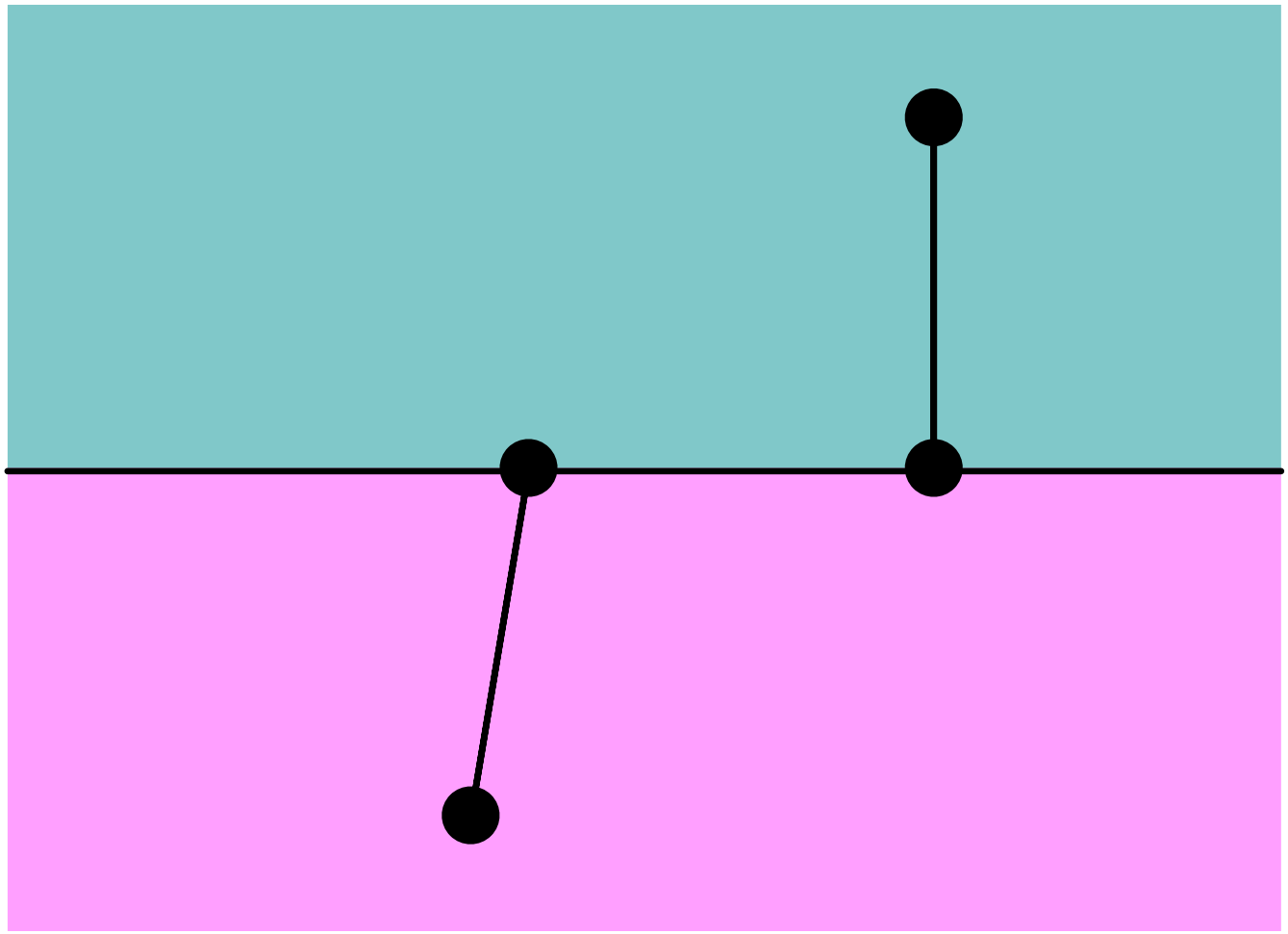
- Tolerance (*threshold*) is used for *snapping* vertices
- Tolerance based on scale of datasets
- Works fine for *simple* problems

Snapping is error-prone and “dangerous”



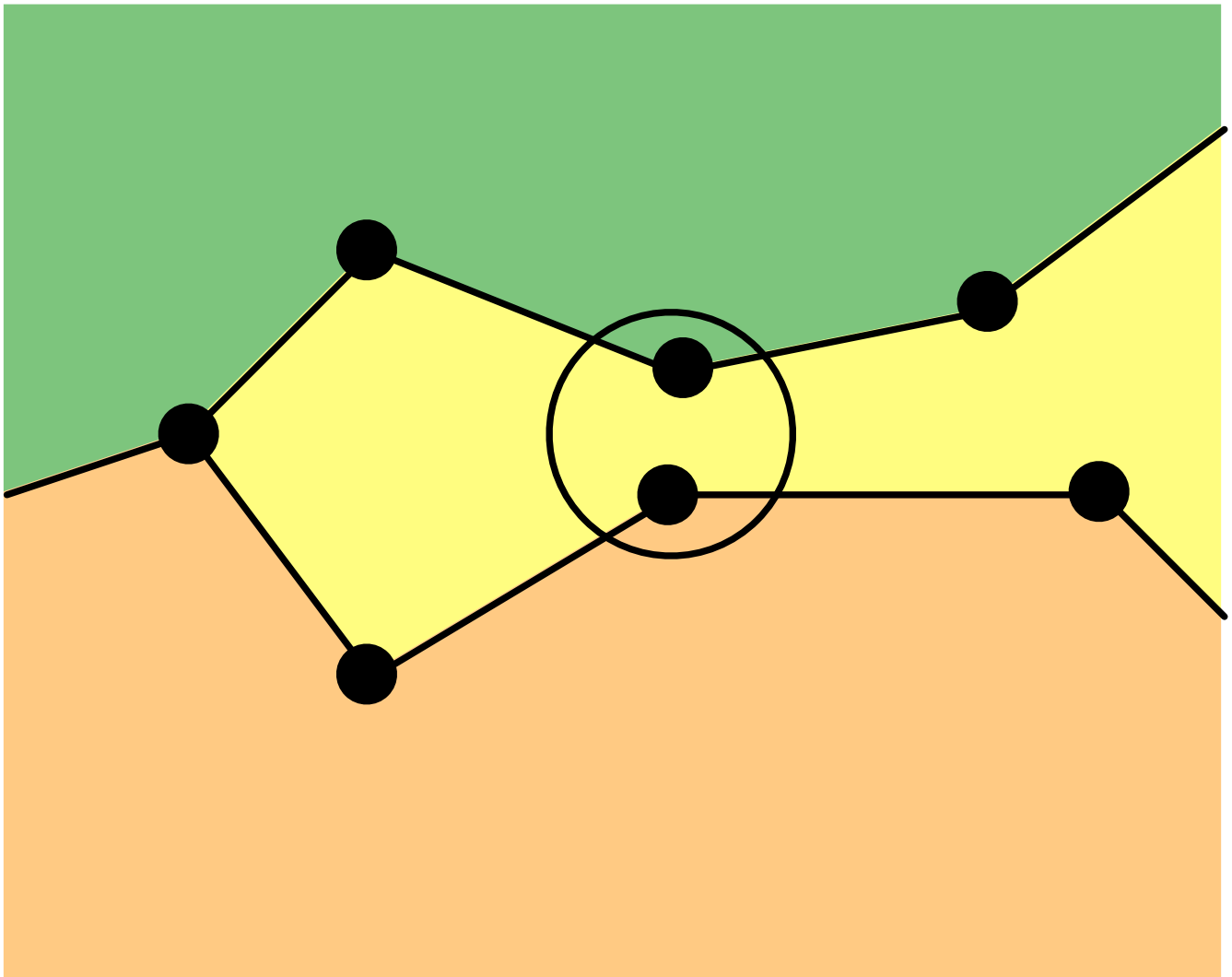
Spikes and punctures can create invalid polygons

Snapping is error-prone and "dangerous"



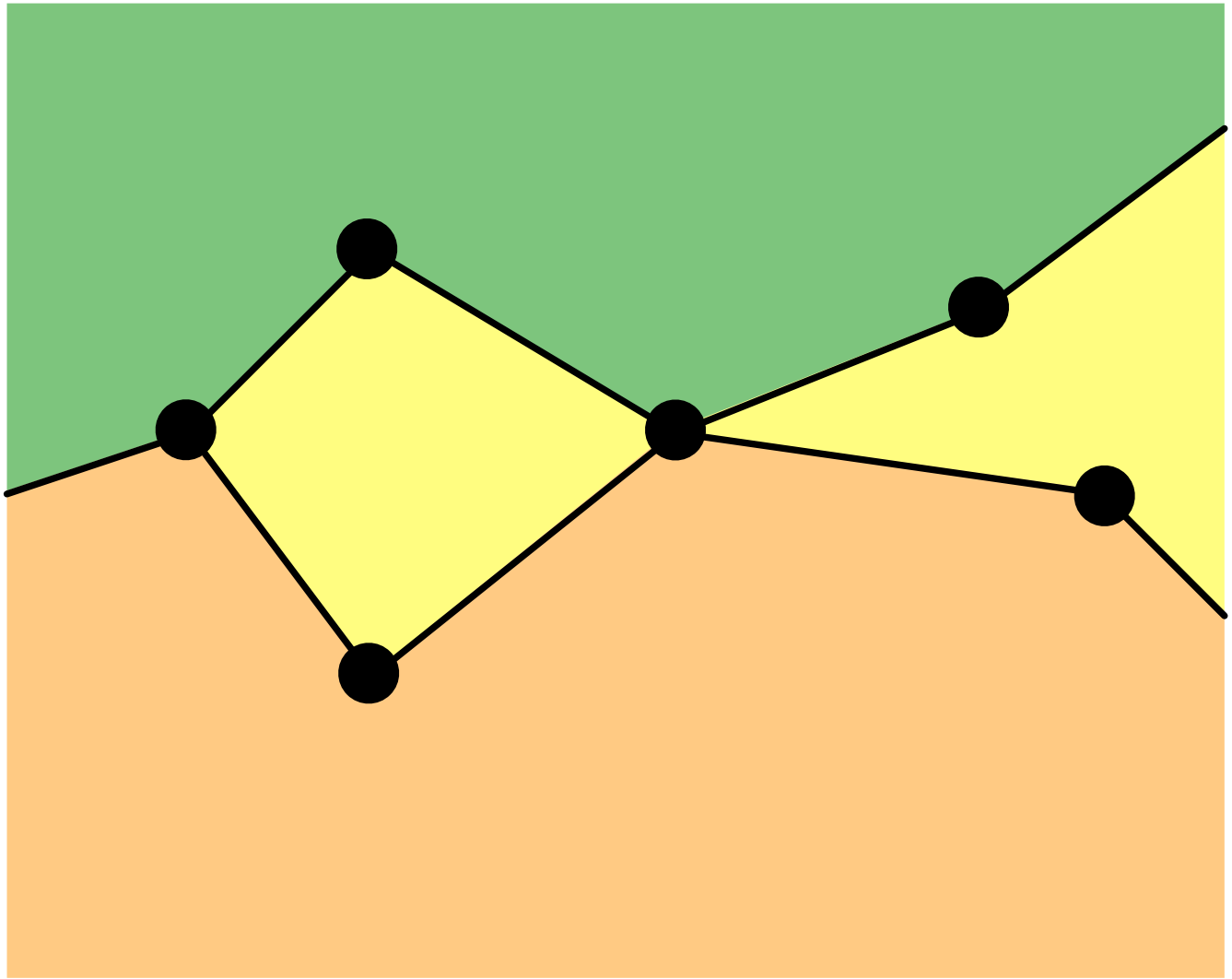
Spikes and punctures can create invalid polygons

Snapping is error-prone and “dangerous”



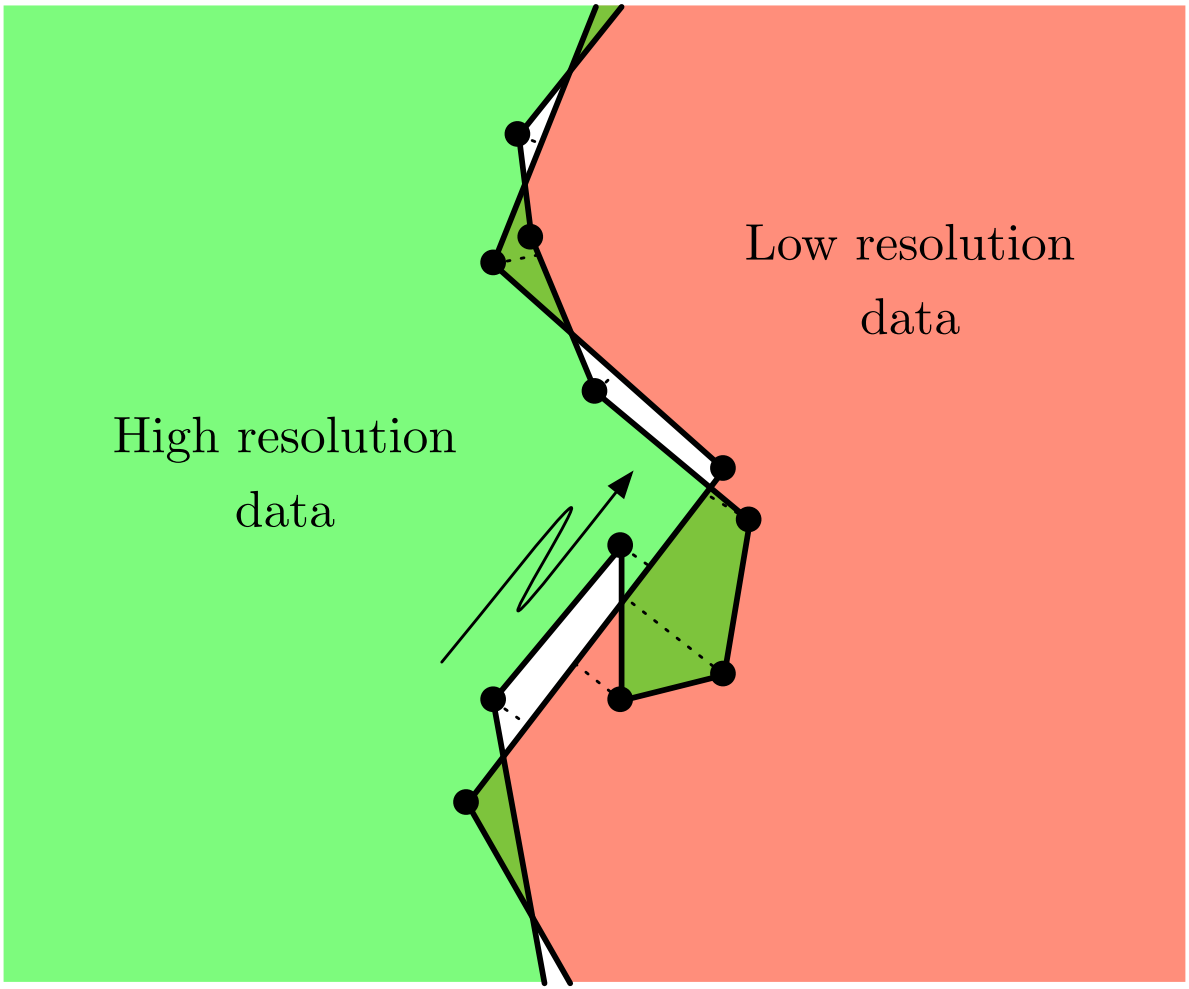
Splitting of polygons into several polygons

Snapping is error-prone and “dangerous”



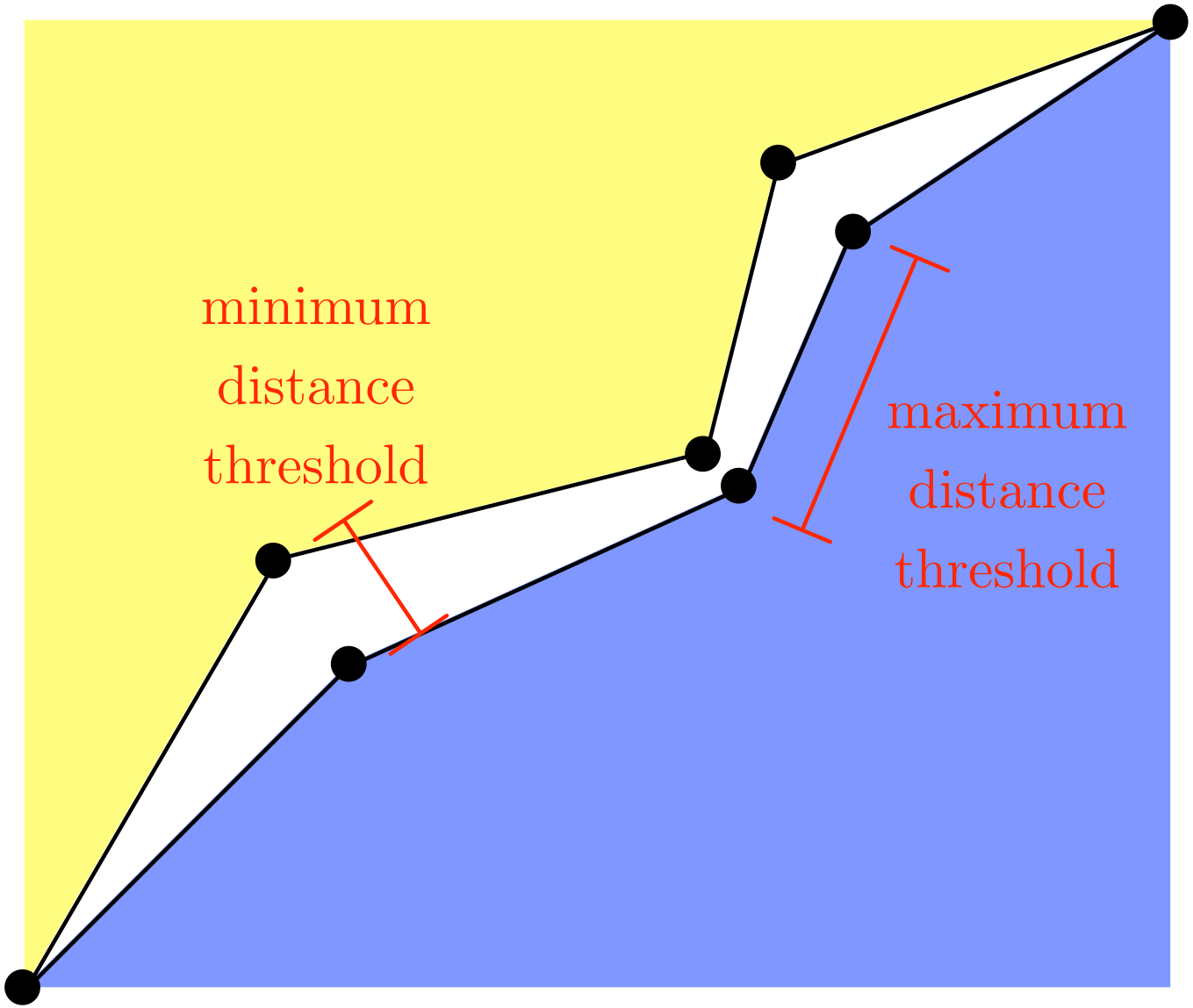
Splitting of polygons into several polygons

Snapping is error-prone and "dangerous"



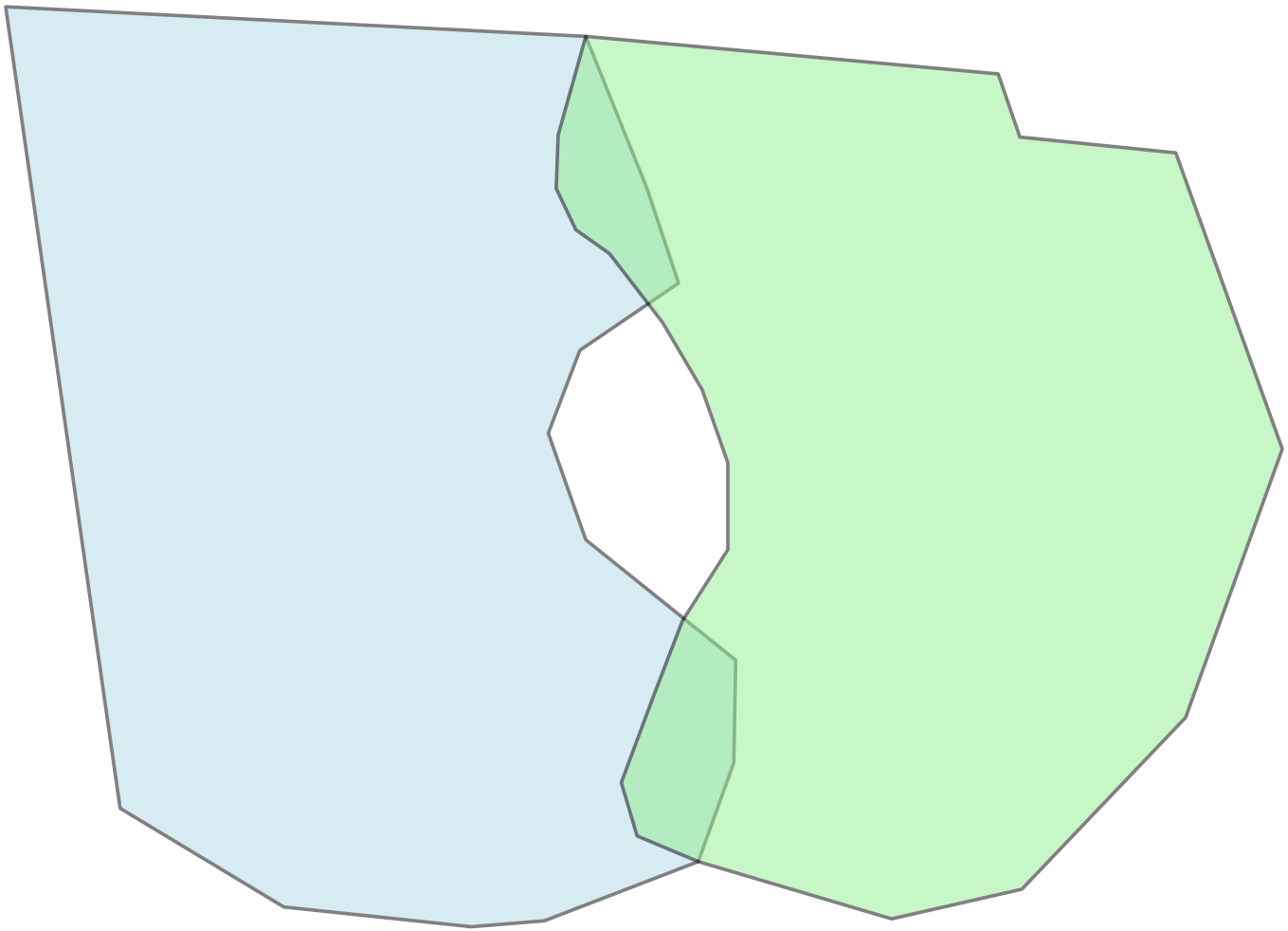
Topological invalid result

The optimal threshold to snap might not exist



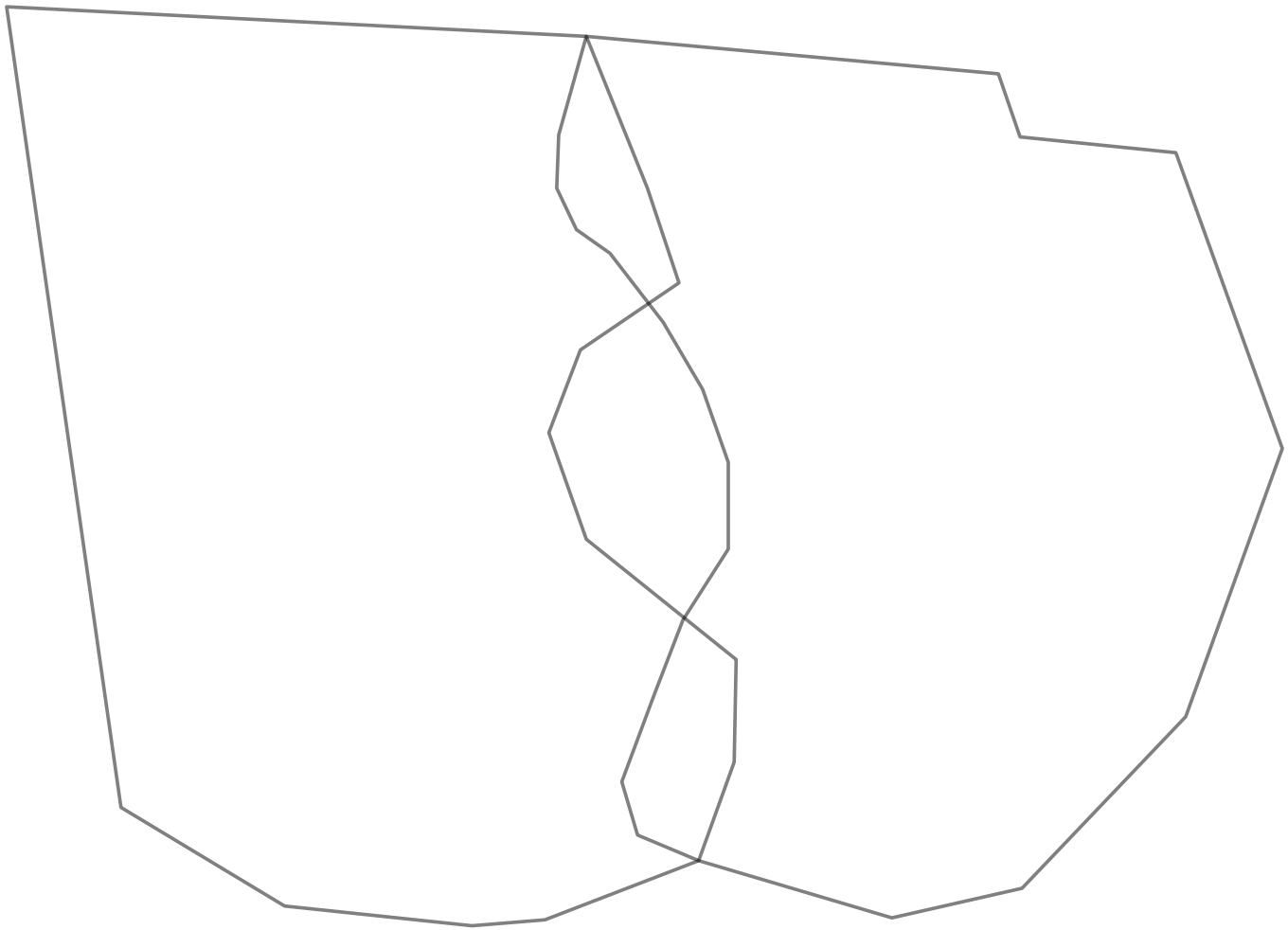
Our solution = constrained triangulation (CT)

1. Construct CT of input polygons
2. Flag each triangle with label of its polygon
3. Problems = triangles with no label or > 1 labels
4. Repair gaps/overlaps *locally* by changing labels



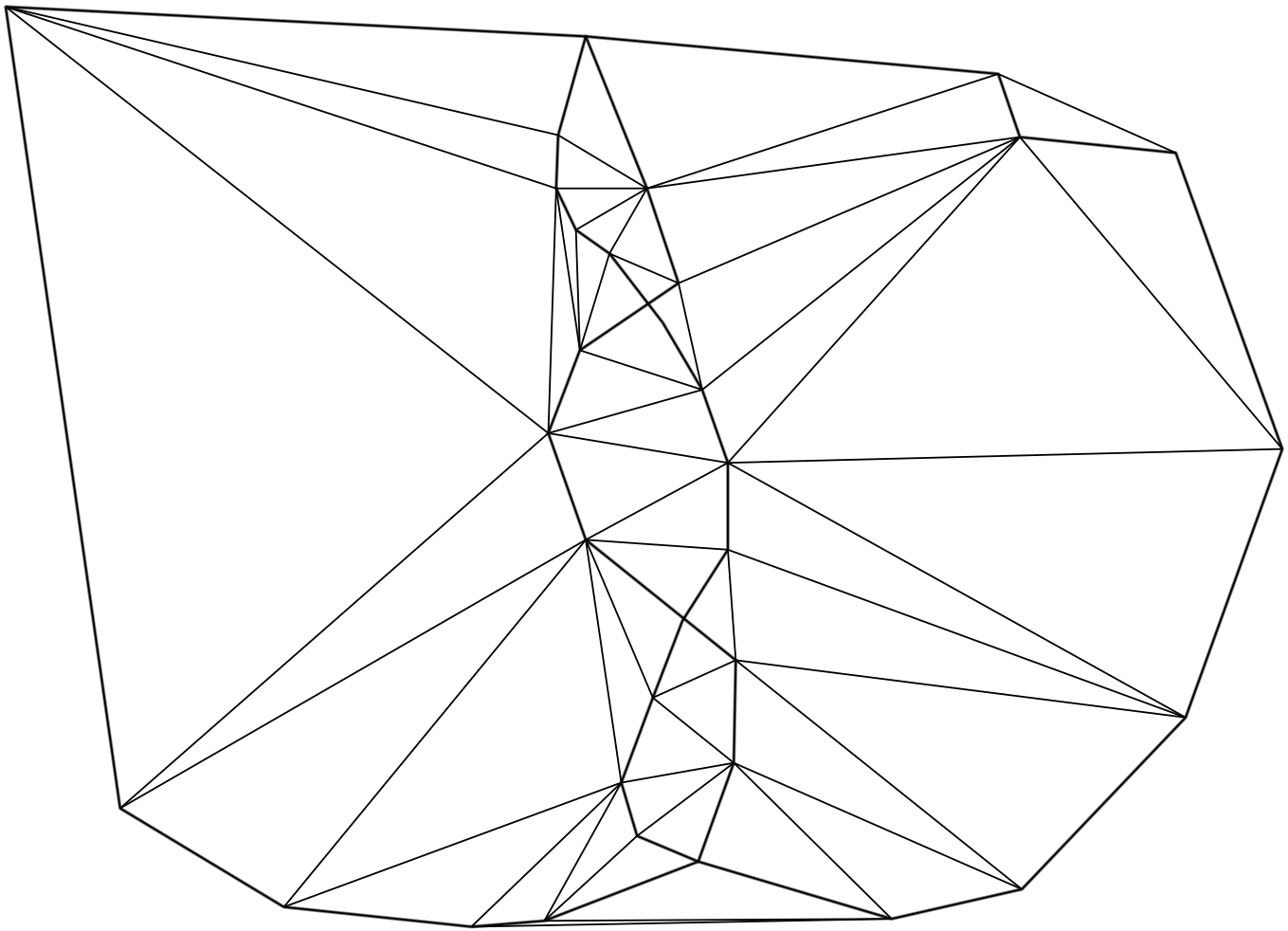
Our solution = constrained triangulation (CT)

1. Construct CT of input polygons
2. Flag each triangle with label of its polygon
3. Problems = triangles with no label or > 1 labels
4. Repair gaps/overlaps *locally* by changing labels



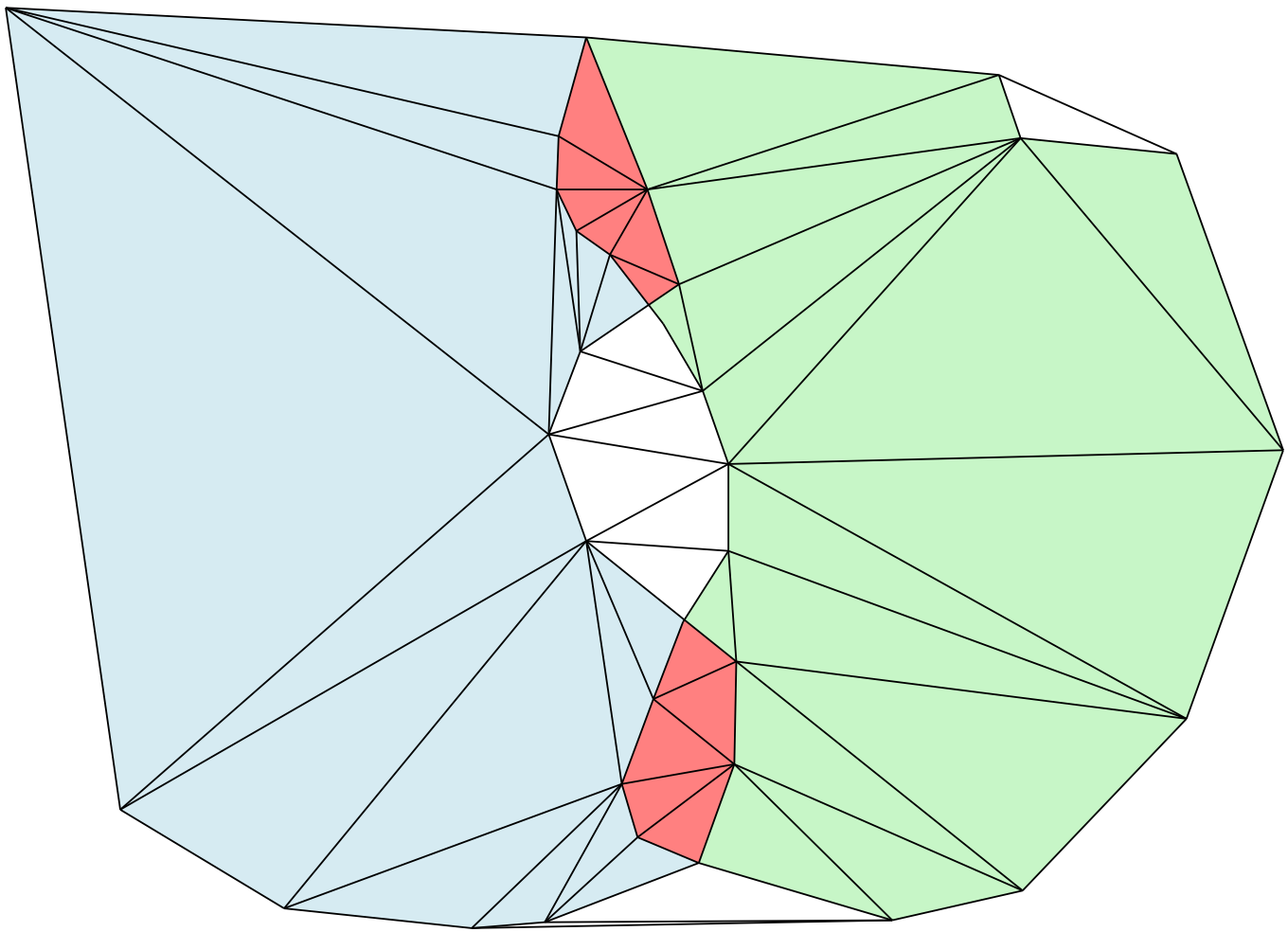
Our solution = constrained triangulation (CT)

1. Construct CT of input polygons
2. Flag each triangle with label of its polygon
3. Problems = triangles with no label or > 1 labels
4. Repair gaps/overlaps *locally* by changing labels



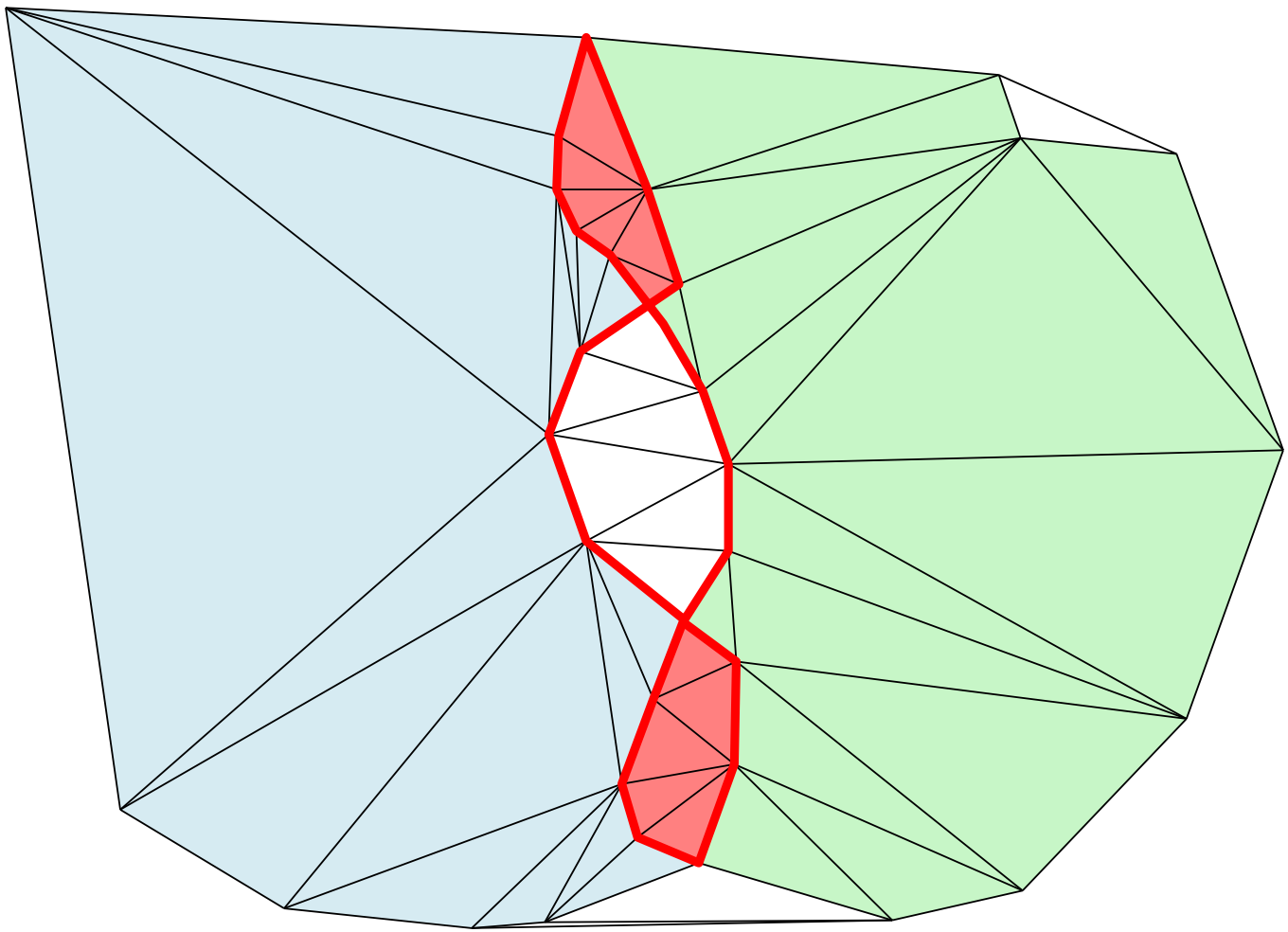
Our solution = constrained triangulation (CT)

1. Construct CT of input polygons
2. Flag each triangle with label of its polygon
3. Problems = triangles with no label or > 1 labels
4. Repair gaps/overlaps *locally* by changing labels



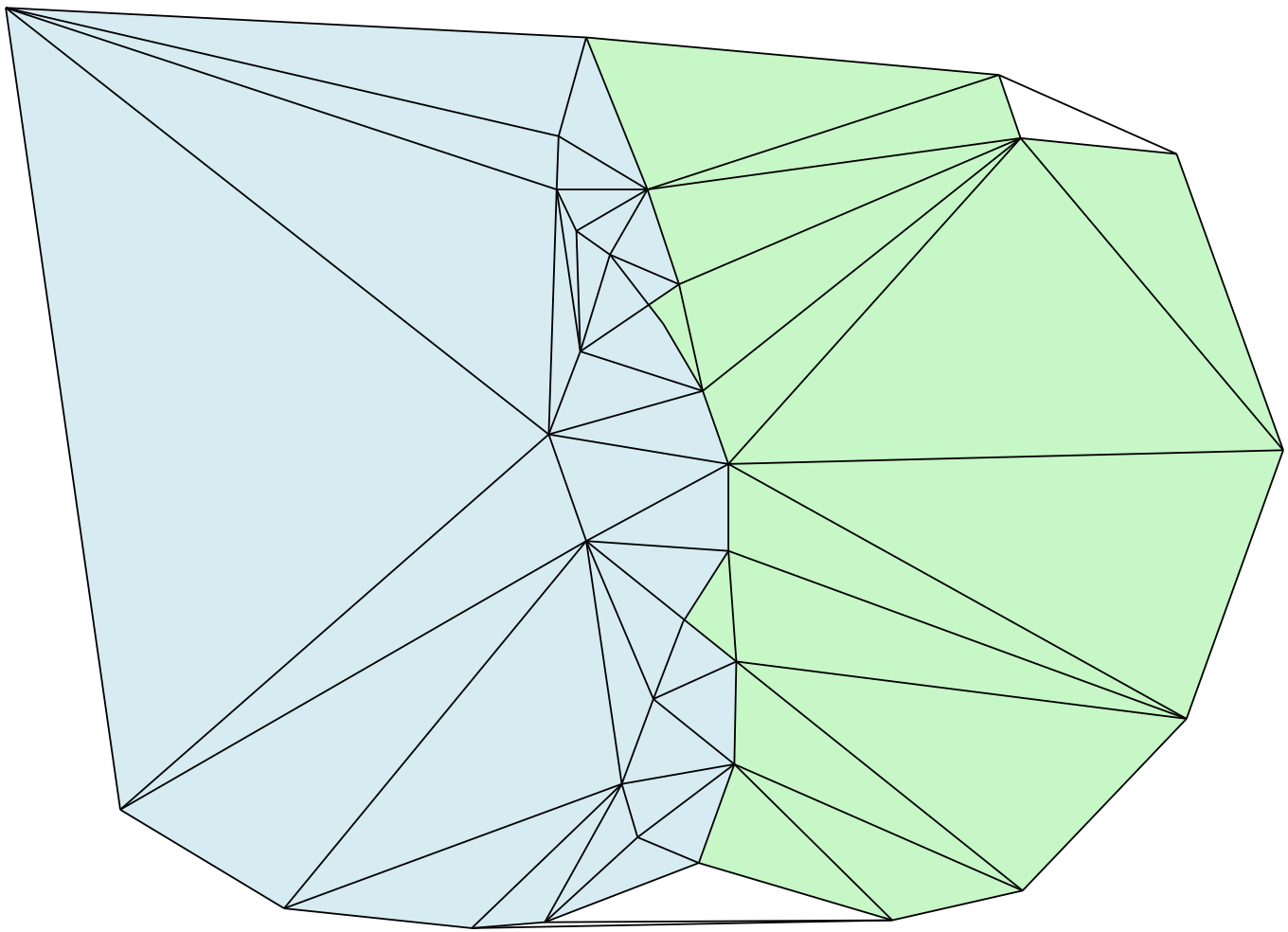
Our solution = constrained triangulation (CT)

1. Construct CT of input polygons
2. Flag each triangle with label of its polygon
3. Problems = triangles with no label or > 1 labels
4. Repair gaps/overlaps *locally* by changing labels



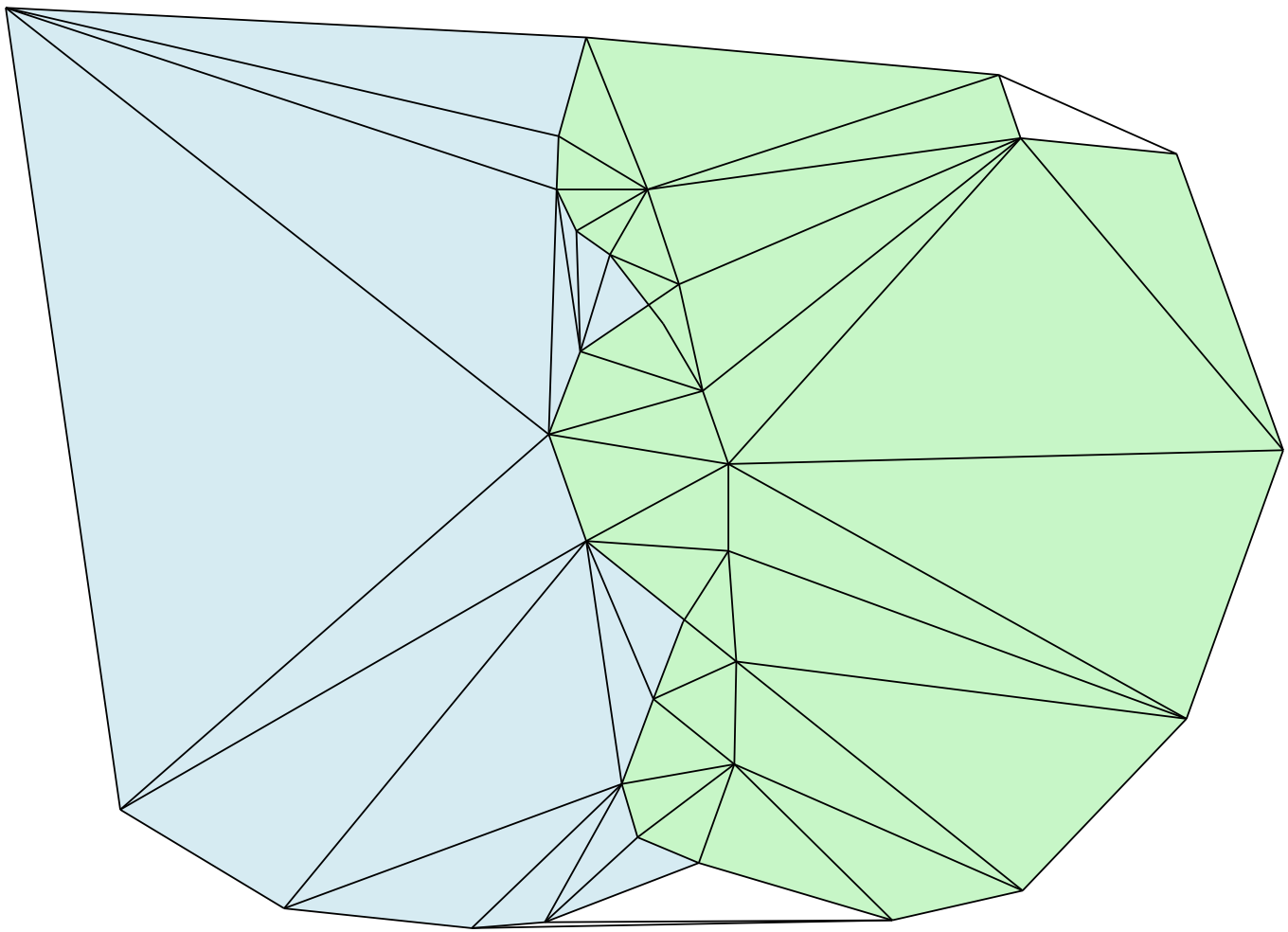
Our solution = constrained triangulation (CT)

1. Construct CT of input polygons
2. Flag each triangle with label of its polygon
3. Problems = triangles with no label or > 1 labels
4. Repair gaps/overlaps *locally* by changing labels



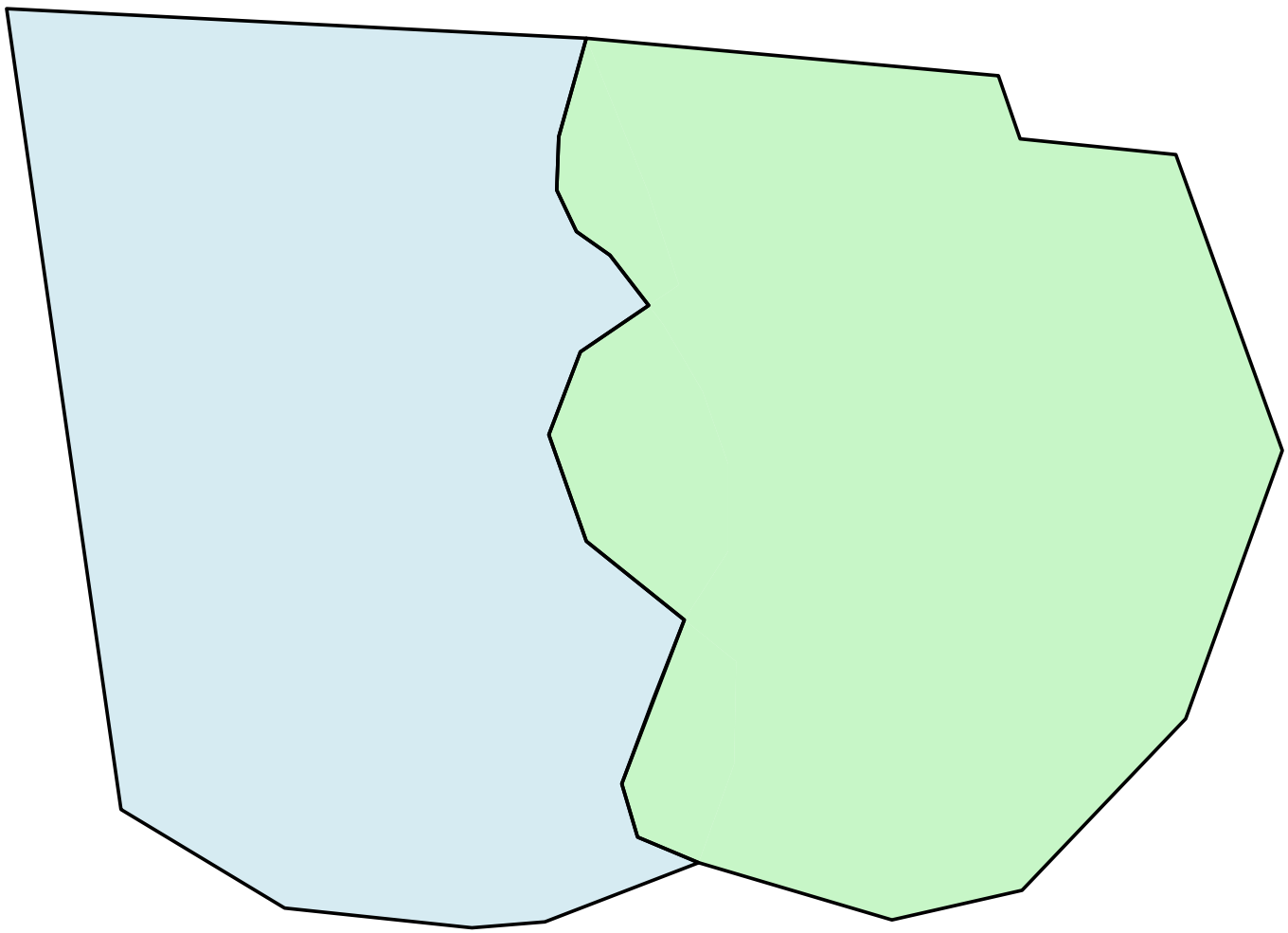
Our solution = constrained triangulation (CT)

1. Construct CT of input polygons
2. Flag each triangle with label of its polygon
3. Problems = triangles with no label or > 1 labels
4. Repair gaps/overlaps *locally* by changing labels



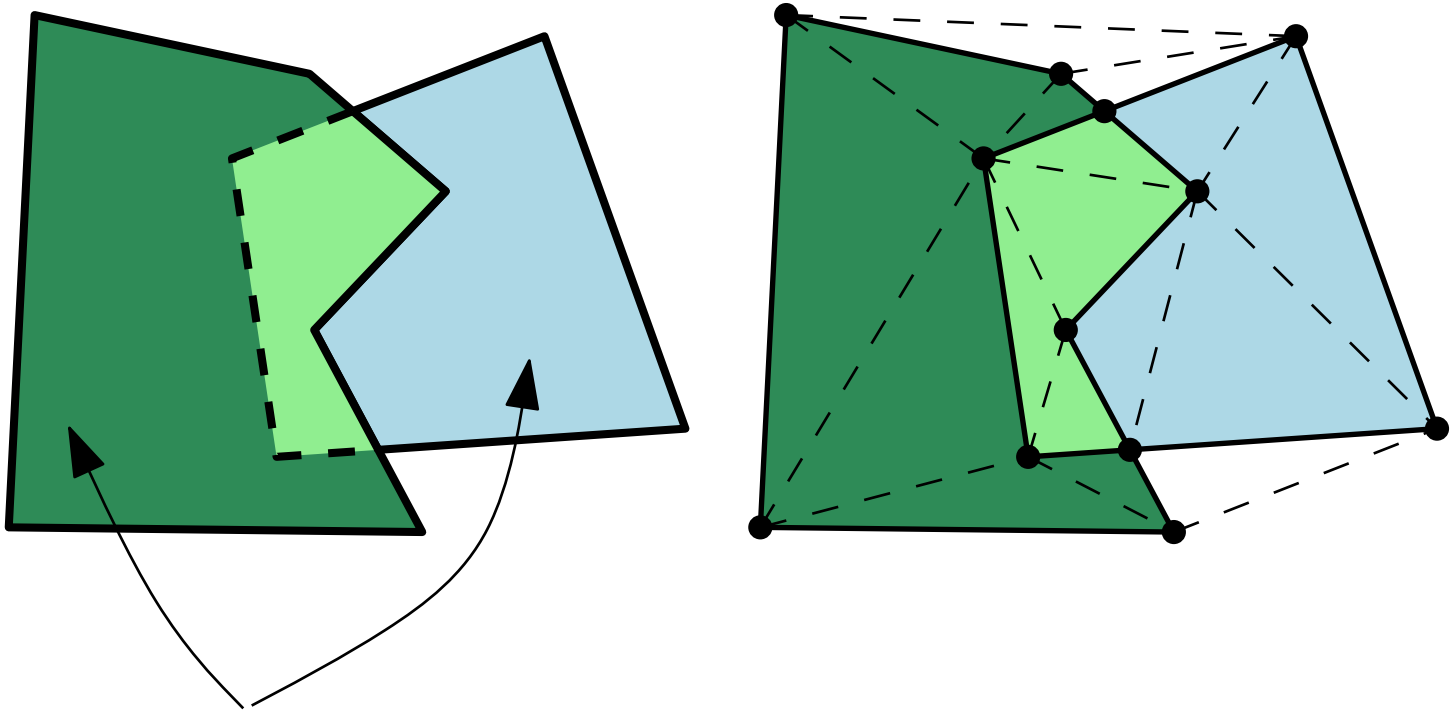
Our solution = constrained triangulation (CT)

1. Construct CT of input polygons
2. Flag each triangle with label of its polygon
3. Problems = triangles with no label or > 1 labels
4. Repair gaps/overlaps *locally* by changing labels



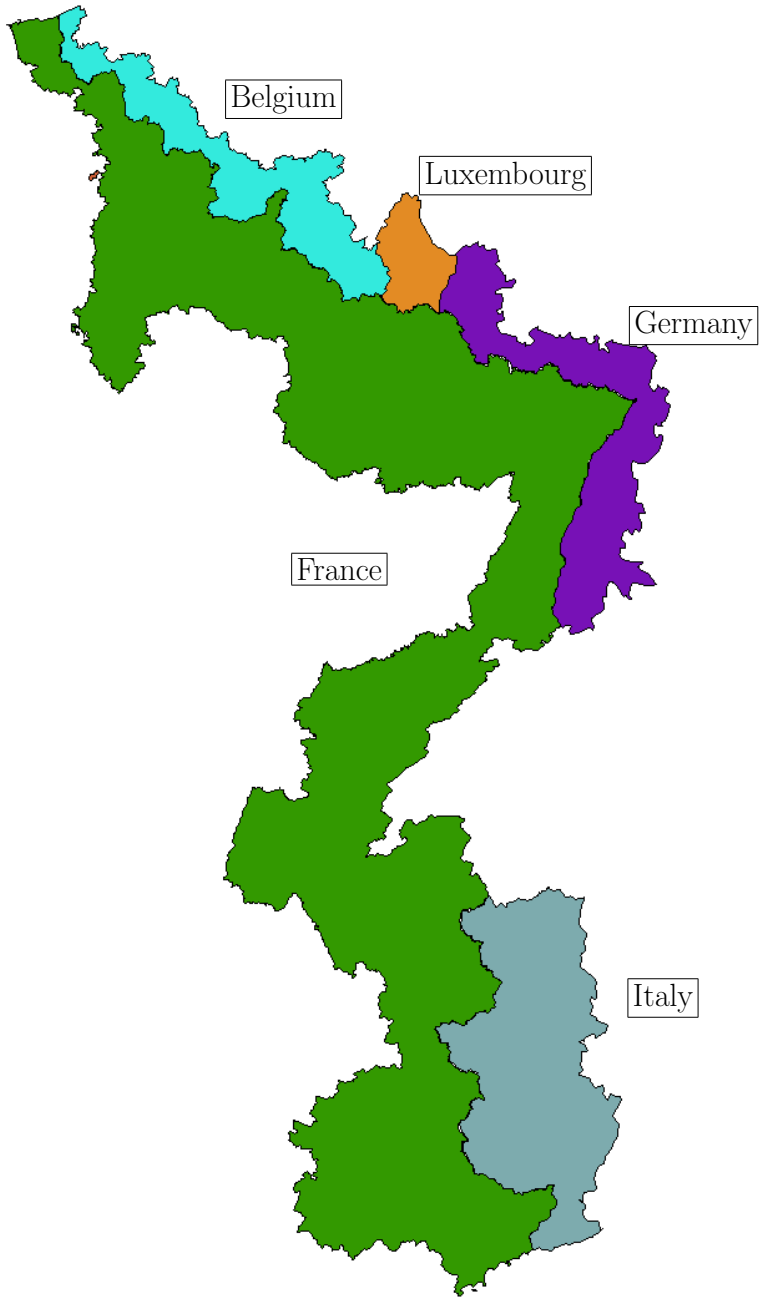
Implementation

1. Fast implementation in C++, with CGAL and OGR
2. Open-source code, you can test it
3. Numerical and geometric robustness. Points do not move during processing.

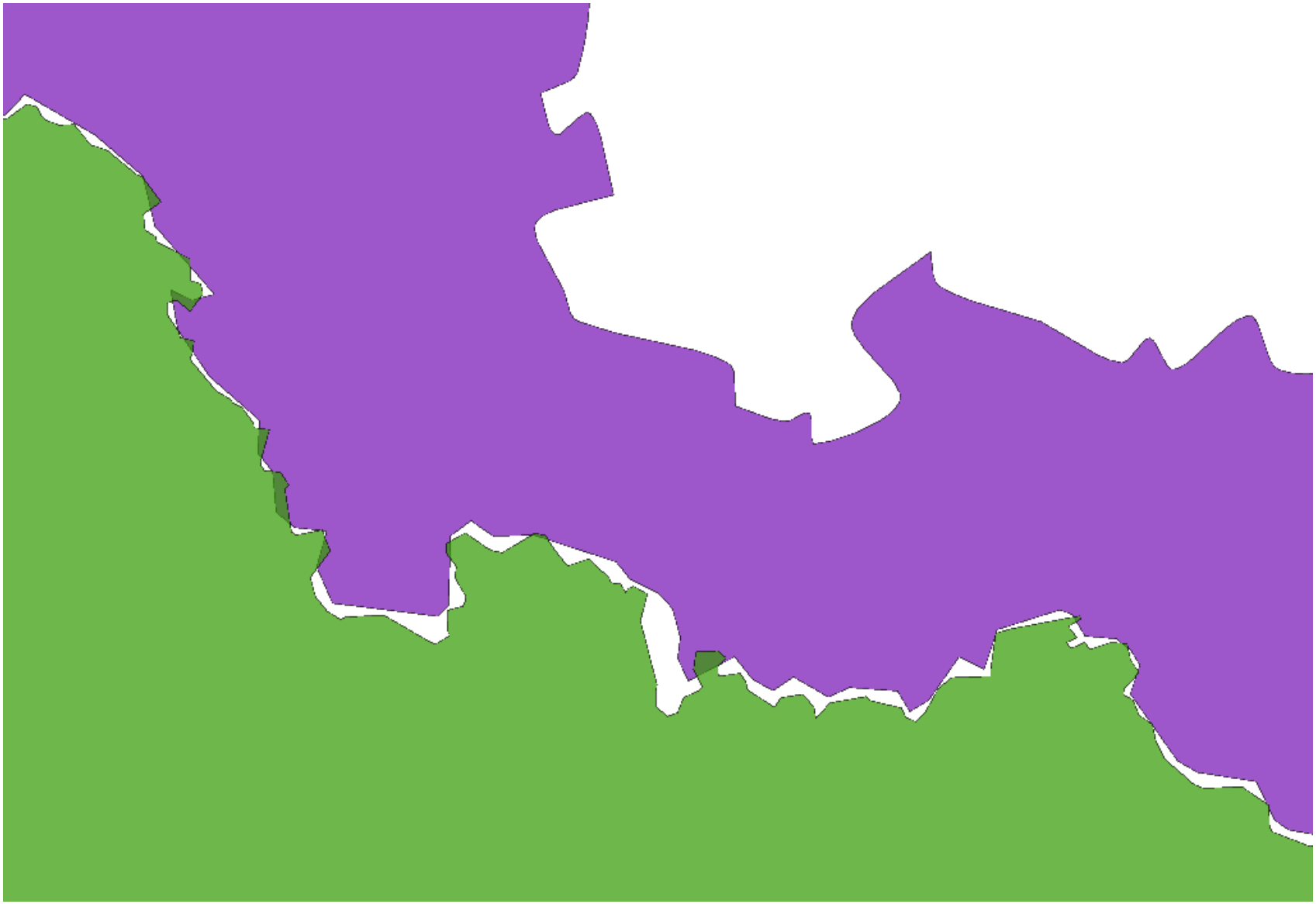


2 input polygons that overlap

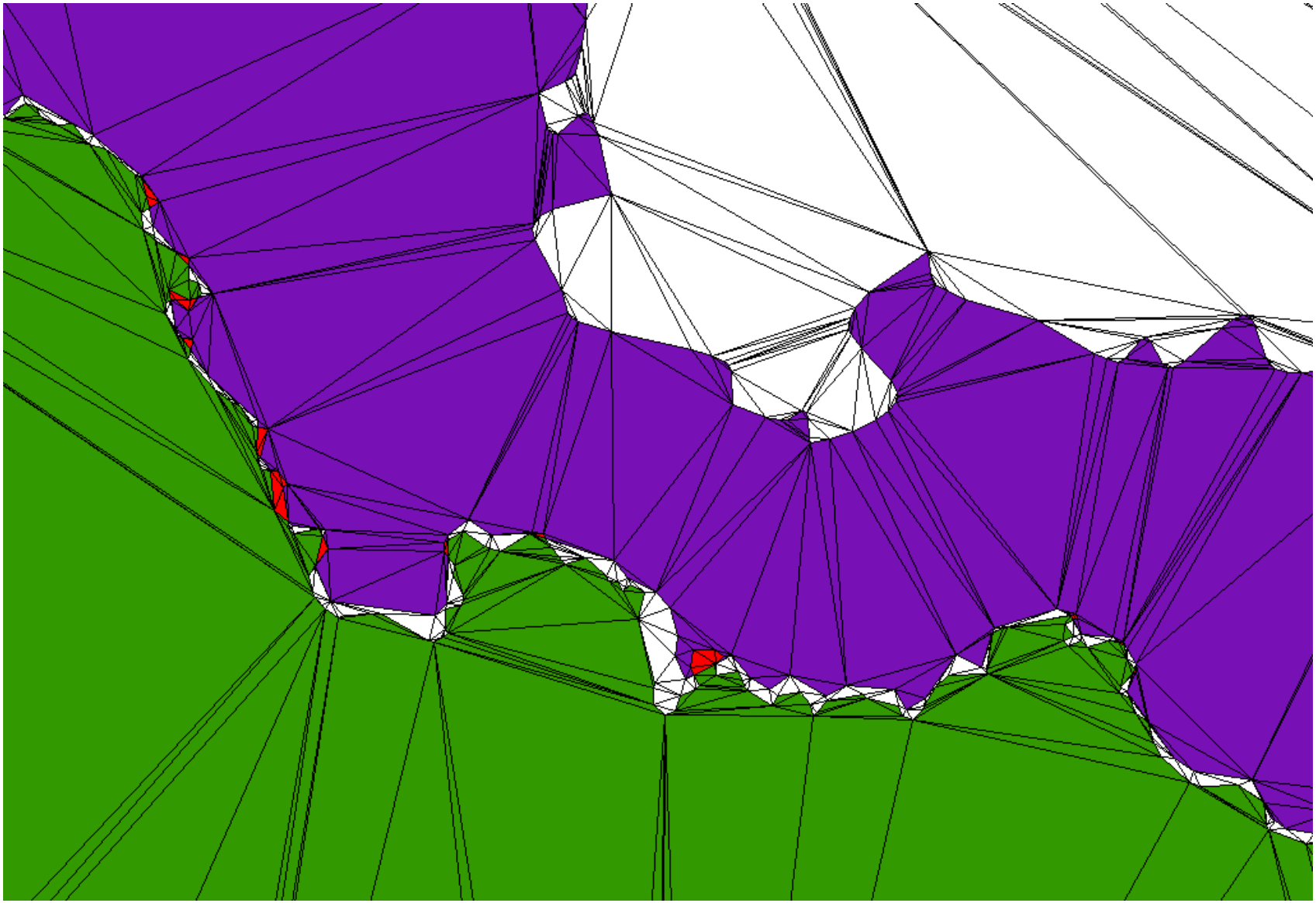
Experiments with real-world datasets



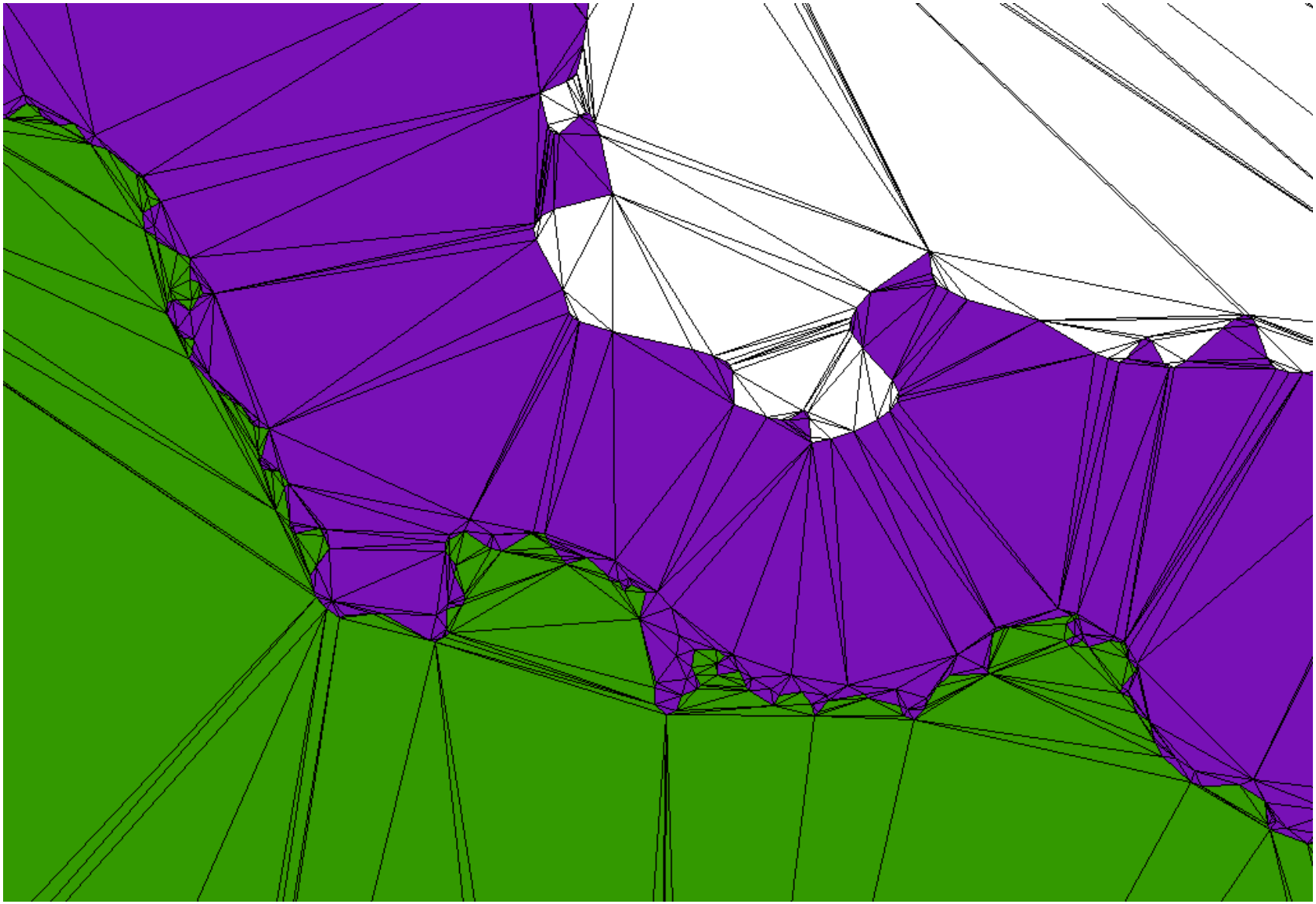
Experiments with real-world datasets



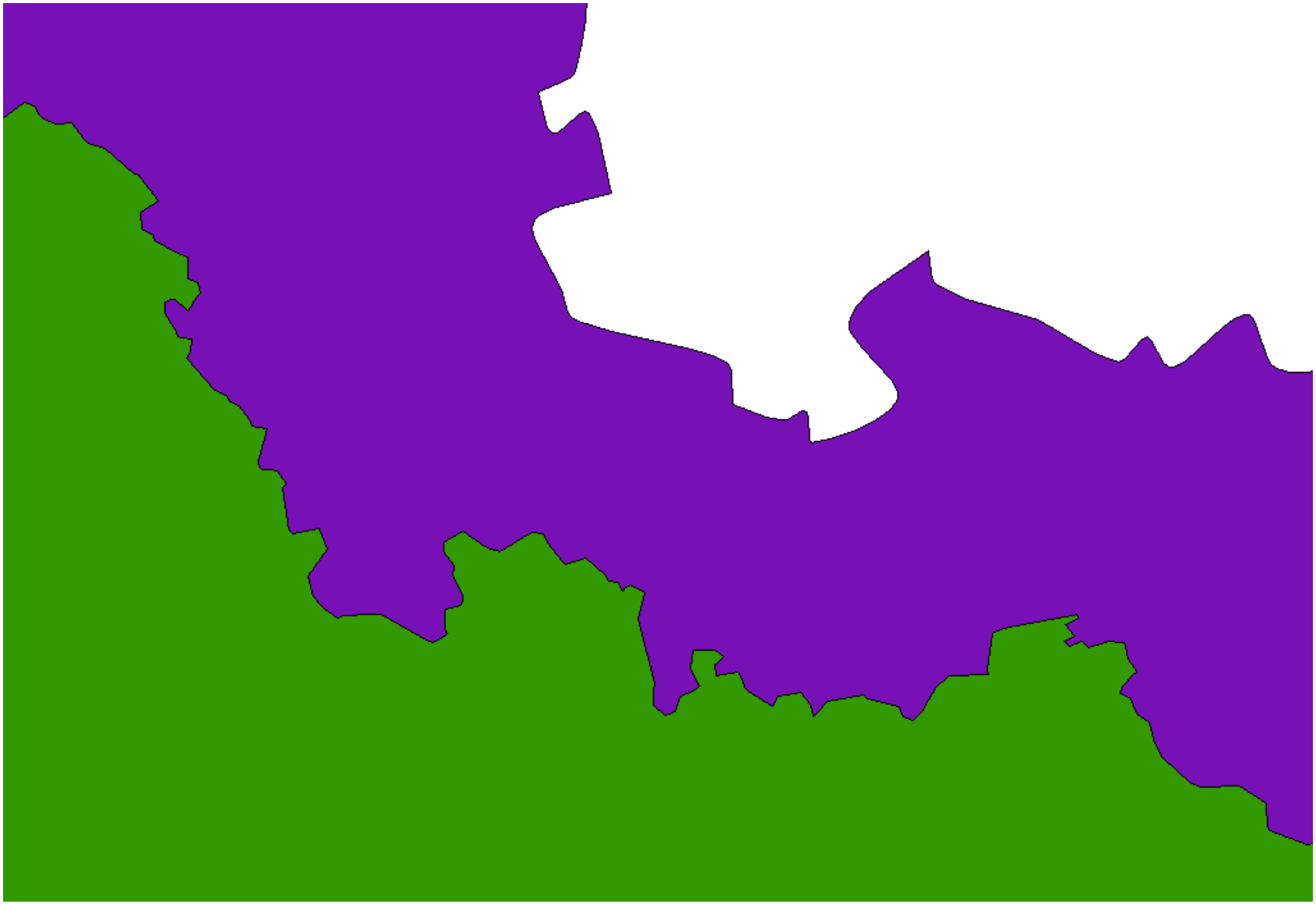
Experiments with real-world datasets



Experiments with real-world datasets



Experiments with real-world datasets

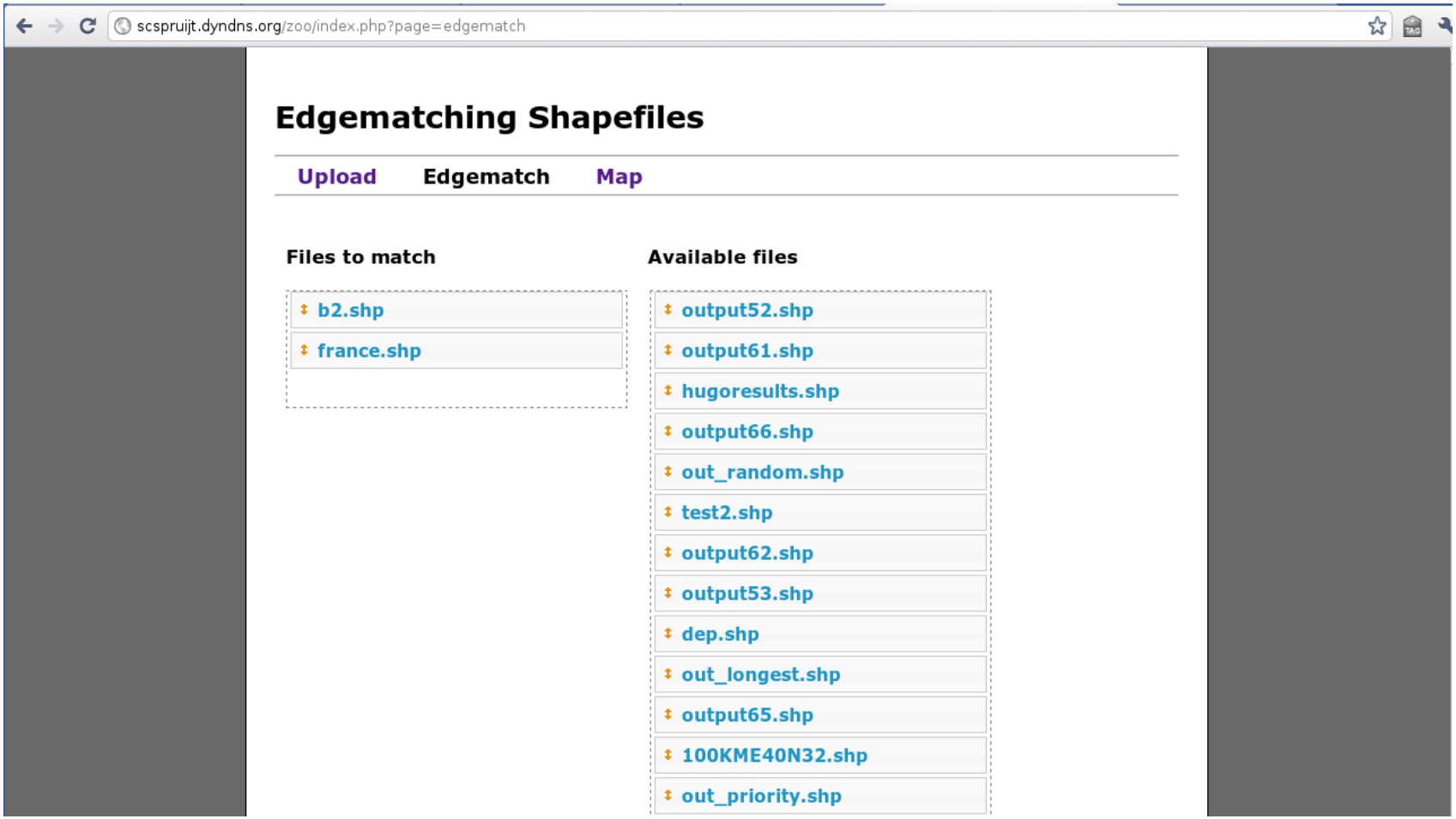


Experiments with real-world datasets

Experiments with CORINE dataset

Can process around 40 tiles in < 1h
(around 120 000 polygons with 4GB main memory)

Web Processing Service (WPS)



Advantages of a triangle-based approach

- Fast and robust (based on CGAL)
- No user-defined tolerance needs to be defined
- Local control of the the edge-matching process
- Results are guaranteed to be valid (geometrically and topologically)

Thanks for your attention

Hugo Ledoux
h.ledoux@tudelft.nl

Ken Arroyo Ohori
kenohori@gmail.com