‘A Methodology for the Assessment of Generalization Quality

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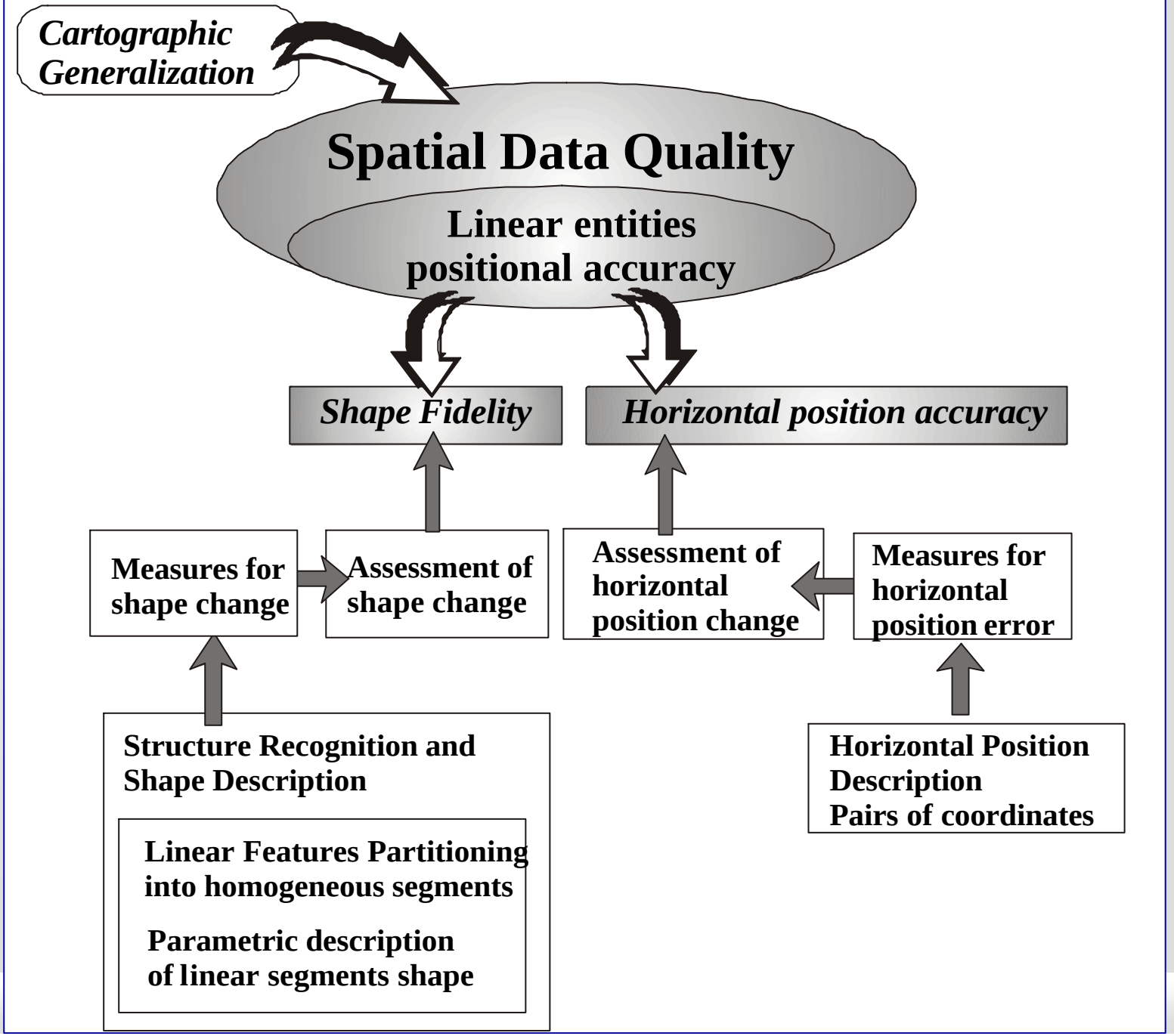
Main Idea


Cartographic Generalization
Spatial Data Quality
Linear entities positional accuracy
Shape Fidelity
Horizontal position accuracy
Measures for shape change
Assessment of shape change
Assessment of horizontal position change
Measures for horizontal position error
Structure Recognition and Shape Description
Linear Features Partitioning into homogeneous segments
Parametric description of linear segments shape
Horizontal Position Description Pairs of coordinates

Parametric Description of Line Shape

➢ **Description of cartographic line shape based on a group of parameters:**

- Bibliographic research
- Data set creation
- Experimental analysis
- Factor analysis
- Final set of parameters:
  - The average magnitude angularity at different vertex ranges
  - The error variance
  - The ratio of line length to anchor line length

➢ **Classification of line segments into similar shape groups using cluster analysis**

Structure Recognition
Partitioning into homogeneous segments

- Methodology applied to natural features based on the variation of the fractal dimension
- Implementation Steps:
  a) Self - similar segments identification along the line to be segmented
  b) Self - similar segments clustering
  c) Selection of a representative segment for each group of segments
  d) Preliminary segmentation
  e) Segmentation refinement
  f) Final Segmentation

Measures for Positional Accuracy [I]
Line shape change

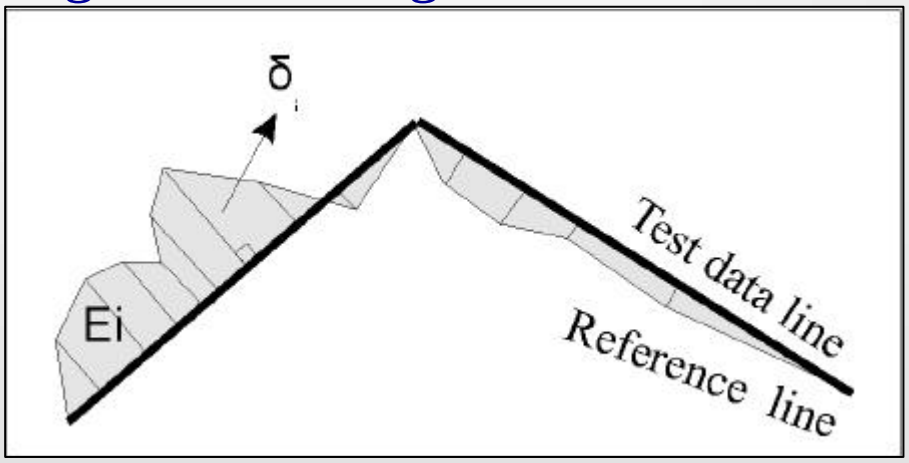
- Quantitative assessment – shape change measure
  - The distance between the original and the generalized line in the parameters' space implies shape modification.
  - The average value of the shape change, for the lines which make up a group, represents the average line shape change for this group.
- Qualitative assessment – classification results
  - When non-hierarchical cluster analysis is applied, using the centers of the original lines groups, the results describe the generalized lines similarity to the original lines.
  - When hierarchical cluster analysis is applied, the results show the similarity between the generalized lines.

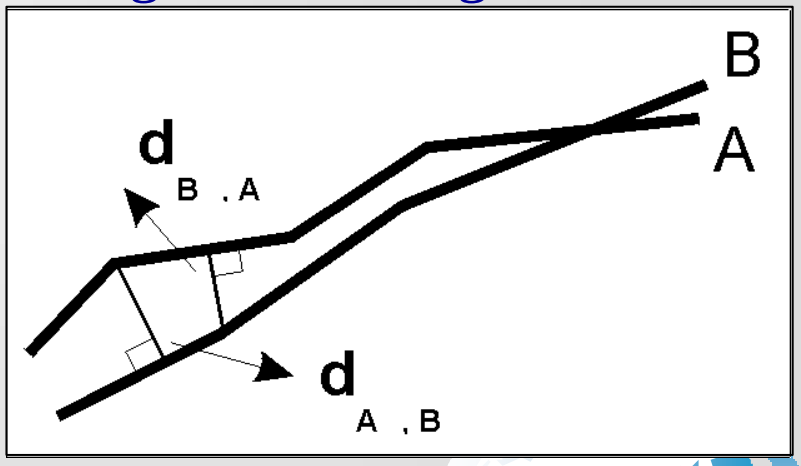
Measures for Positional Accuracy [II]

Horizontal position

Distance measures: Average Euclidean distance, Hausdorff distance

Areal displacement measures: the ratio of the area between the original and the generalized line to the length of the original line





Average Euclidean distance

$$d(\mathrm{A},\mathrm{B}) = m_d = \frac{\sum_{i=1}^{K} d_i}{K}$$

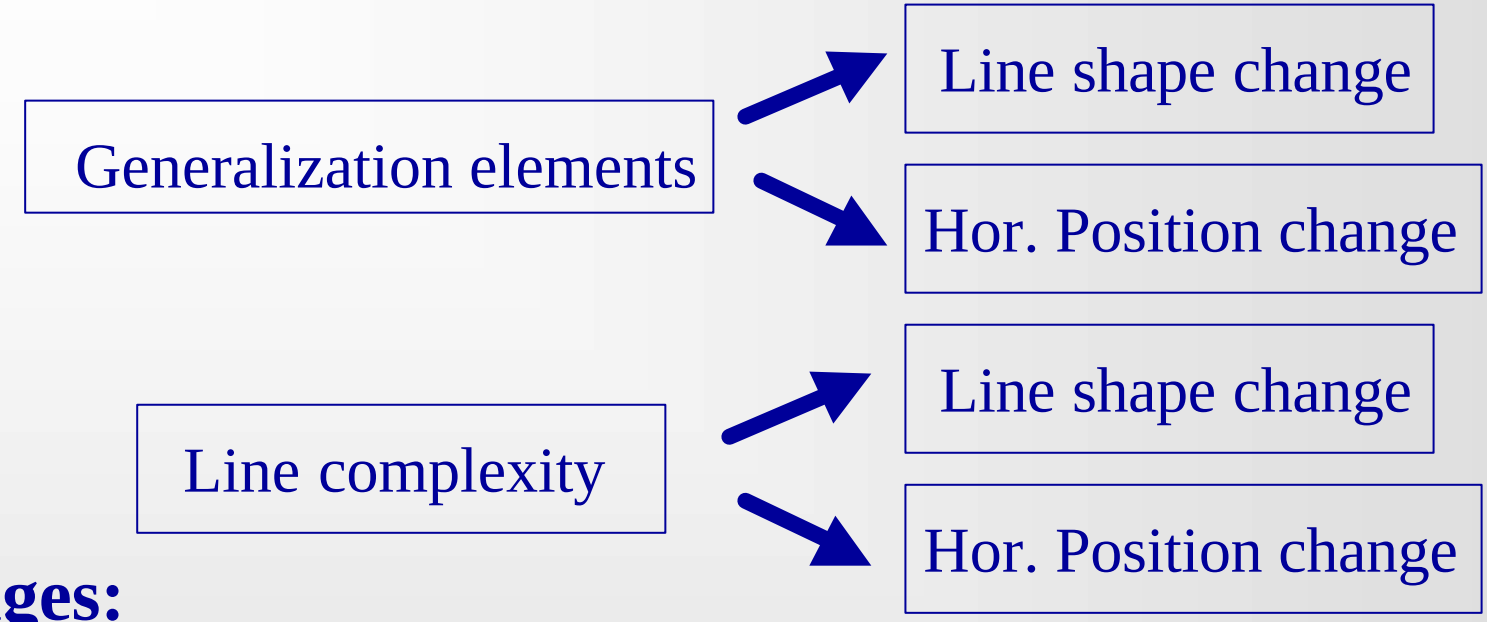
Areal displacement

$$E_{ol} = \sum E_i / L$$

Hausdorff distance

$$d_H(A,B) = \max(d_{AB}, d_{BA})$$

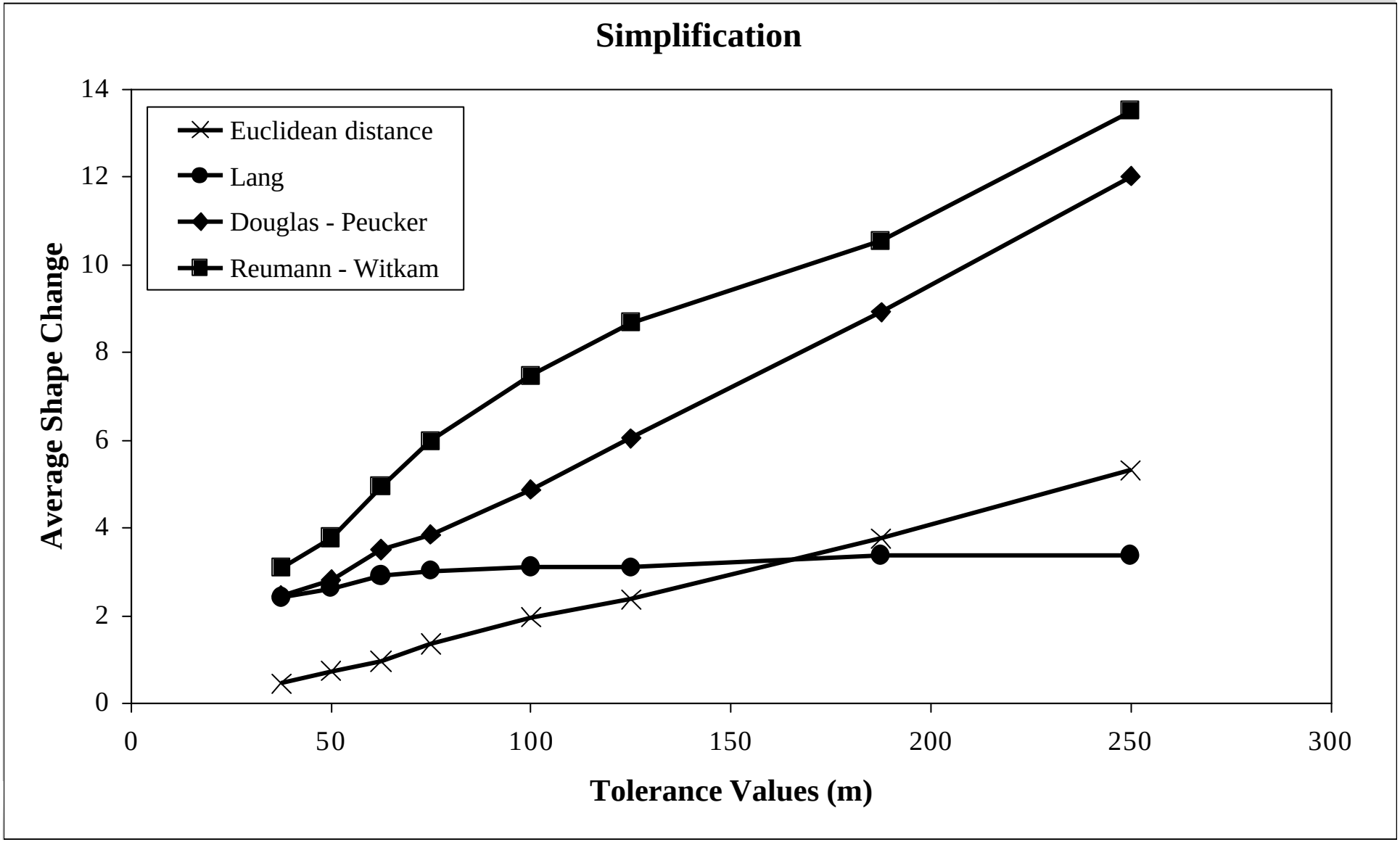
Positional Accuracy Study



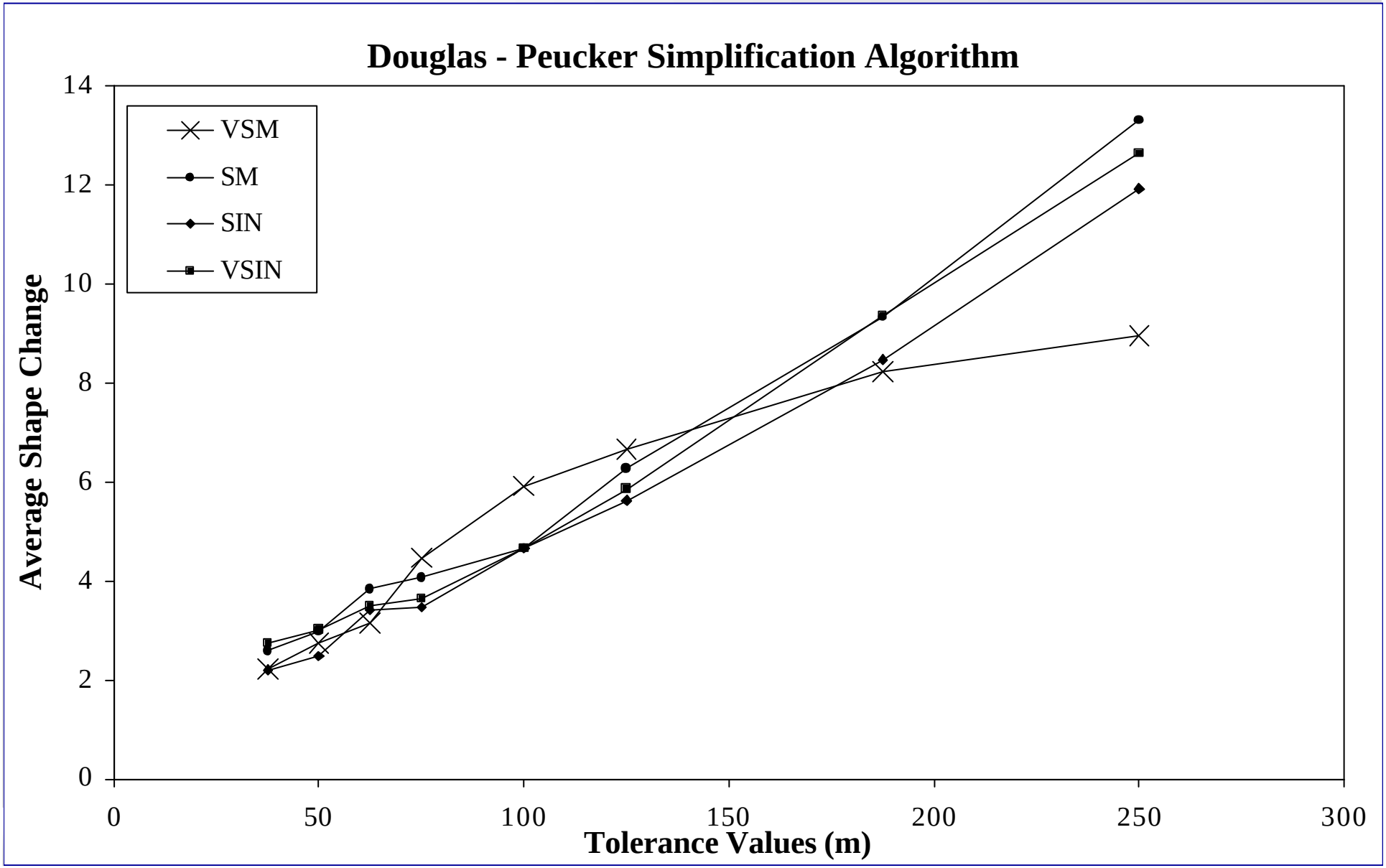
Stages:

- Linear features partitioning in homogeneous segments
- Parametric description of linear segments shape and clustering in groups with similar shape
- Implementation of several generalization solutions (operators, algorithms and tolerance values)
- Assessment of the positional accuracy

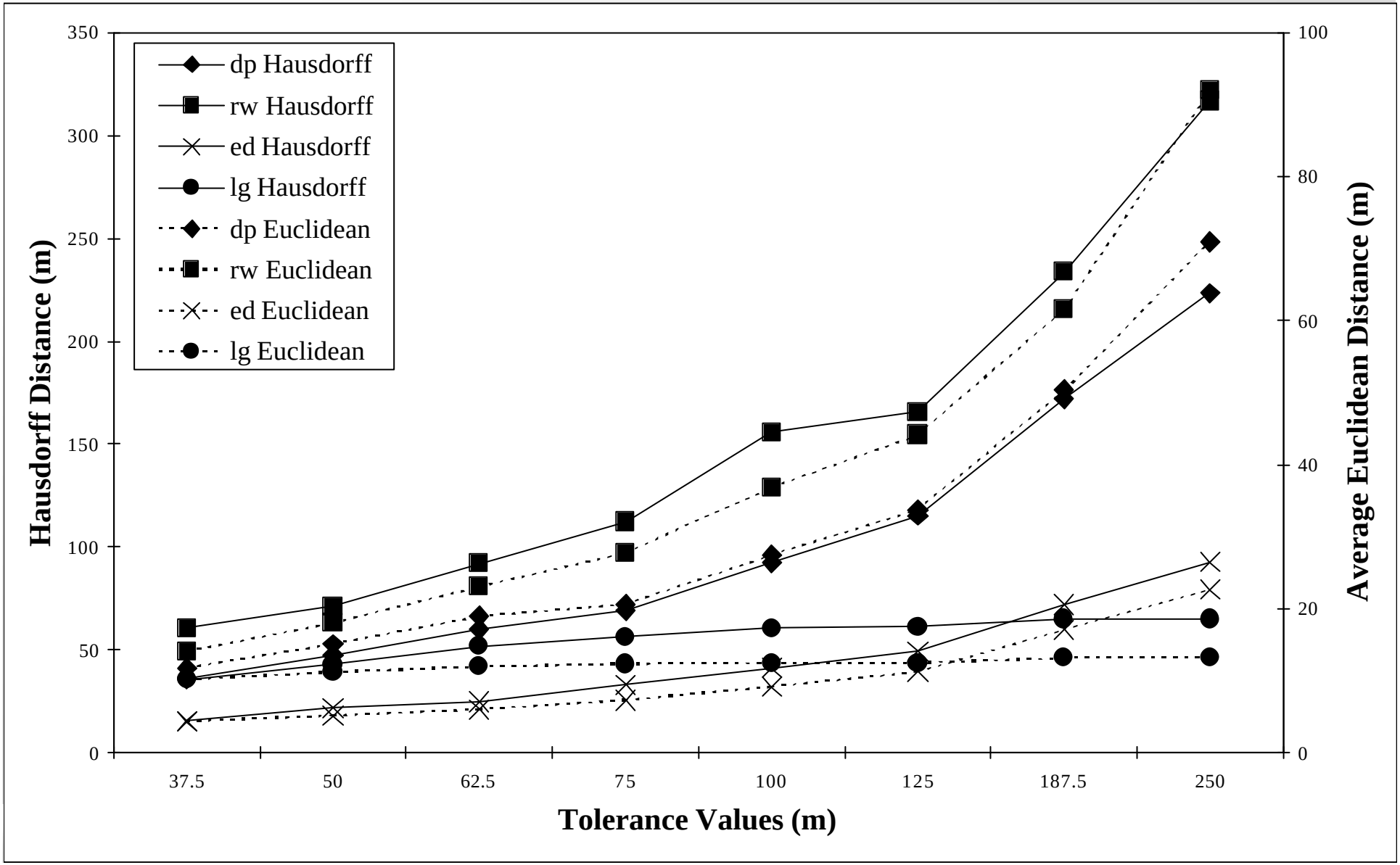
Comparison of Shape Change by Algorithm and Tolerance Value



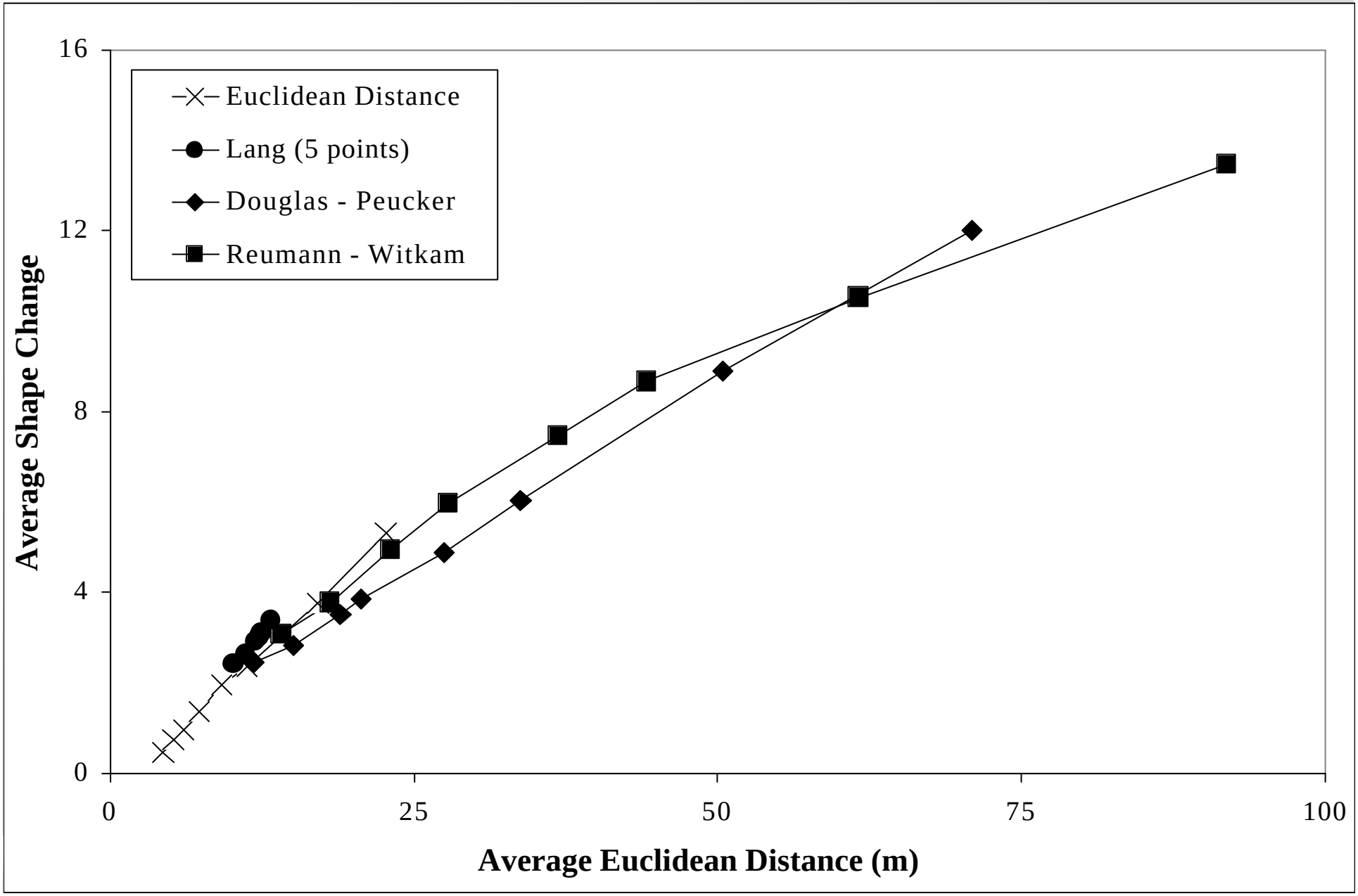
Algorithms Influence on Line Groups of Different Shape



Horizontal Position Error by Algorithm and Line Category



Overall Positional Accuracy



Line Shape change: Classification results

- The number of groups
- The synthesis of the generalized lines groups

Original			Simplified					
Scale x 1000		100	200	500	1000	200	500	1000
Line Code	Group		Hierarchical			Non-hierarchical		
4	VSM	1	1	1	1	1	1	1
9		1	1	1	1	1	1	1
14		1	1	2	1	1	1	1
1	SM	2	2	2	1	2	1	1
7		2	2	2	1	1	1	1
10		2	2	2	1	1	1	1
13		2	2	2	1	2	2	1
16		2	2	2	1	2	2	1
2	SIN	3	3	3	2	2	2	2
3		3	3	3	2	3	3	2
6		3	3	3	2	3	2	2
8		3	4	4	2	3	3	2
12		3	3	3	2	3	3	2
5	VSIN	4	4	4	3	4	3	3
11		4	4	4	3	4	3	3
15		4	4	4	3	3	3	3
17		4	4	4	3	4	4	3
18		4	4	4	2	4	3	2
Nu. of Groups		4	4	4	3	4	4	3

Assessment of generalization quality

Assessment Tools

- **Measures:**
  - The average shape change
  - The average horizontal position
  - The number of groups
  - The synthesis of the generalized lines groups

Constraints:

- min shape distortion
- min hor. position error
- maintenance of shapes variety
- preservation of the original line characteristics

Knowledge acquisition

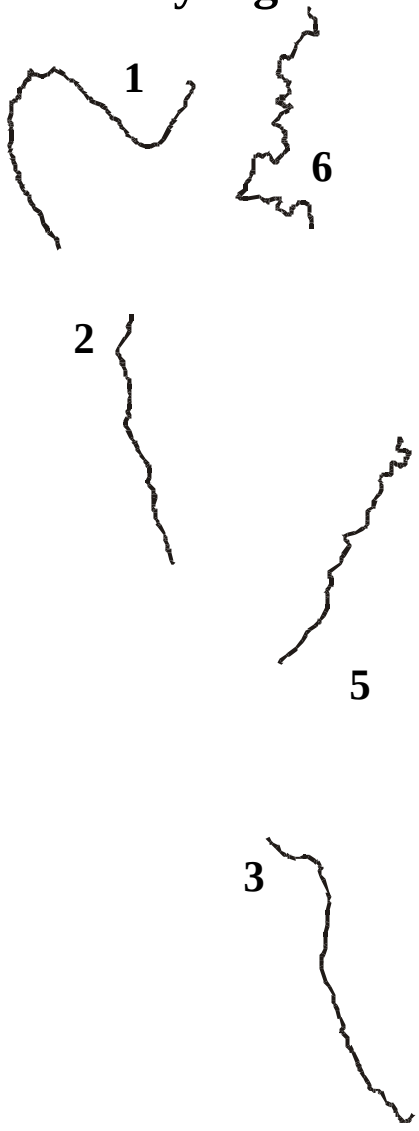
- Comparison of "exemplars" and "automated generalization" results
  - with quantitative measures, without human intervention
  - objective selection
- Shape and structure recognition is applied to the original data
- Procedural knowledge: structural knowledge is related to the selected automatic generalization solution

Shape Description and Structure Recognition [I]

Example: Ithaca Island

Representative Self-Similar Segments

Preliminary segmentation



Shape Description and Structure Recognition [II]

Example: Ithaca Island