Comparison of different processes to combine road generalisation algorithms: GALBE, AGENT and CartoLearn

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Outline

• General approach of the 3 processes
• Overview of the 3 processes
• Analysis & comparison of the ‘key points’
• Conclusion
General approach of the 3 processes

- Generalisation = step by step process, several algorithms successively applied on objects, depending on their characteristics (OEEPE test, [Ruas 98])

- Split the road & handle homogeneous parts [Plazanet 96]
Algorithms used by the 3 approaches

• To handle one bend
  - Maximal Break
  - Minimal Break

• To handle bend series
  - Accordion
  - Bend removal

• To handle one road globally
  - Gaussian smoothing
  - Plaster

• To split a road
  - one side coalescence
  - both sides coalescence

• To propagate
The 3 processes

GALBE
[Mustière 98]
Empirical process

AGENT-Road
[AGENT 01, Duchêne 01]

CartoLearn
[Mustière 01]

Engine to chain + Constraints design

Rules to guide Machine learning
The GALBE process [Mustière 98]
The AGENT-Road process [AGENT 01, Duchêne 01]

Characterise & Evaluate

Propose plans

CONSTRANTS: Coalescence, Accuracy, Topology...

Choose best plan & trigger

Re-evaluate

STILL PLANS

SPLITTING?

Accept

Backtrack

NO MORE PLAN

BETTER

WORSE

PERFECT

NOT YET PERFECT

Passive

Choose best micro

Give autonomy

Manage side-effects

Recompose

1 MICRO-AGENT

splitting

MICRO-AGENTS

1 MESO-AGENT

MANAGES

S MUSTIÈRE & C. DUCHÊNE, COGIT Lab., IGN, France - ICA Generalisation Workshop 2001
The CartoLearn process [Mustière 01]

Start:
List $L = \{\text{the initial road}\}$

Select object $O$ from list $L$

What operation has been done?
- Add parts of $O$ to list $L$ [splitting]
- Remove object $O$ from list $L$ [transformation]
- Propagate side effects [transformation]
- Stop [splitting]

Choose algorithm

Learnt rule bases

Choose algorithm

Previous operation

Operation

Applicable algorithms

Algorithm

Measures

Abstract description

End

Reconnect all the parts
Results comparison

- **GALBE**: 😊 Quick. Globally good results. 😞 Problems on complex cases
- **AGENT**: 😊 Handles complex cases correctly 😞 Slow (lots of tries). No smoothing.
- **CartoLearn**: 😊 Handles complex cases correctly 😞 Solutions not always optimal (no comparison)
KEY POINTS OF THE PROCESSES

- Engine & knowledge organisation
- Splitting management
- Choice of the next part of road to generalise
- Choice of the next algorithm to apply
- Validation & continuation
Engine & Knowledge organisation

Engine:

- GALBE: Task specific / Knowledge inside the process
- AGENT & CartoLearn: Generic engine / Knowledge outside (rule bases, constraints)

Associated knowledge:

- GALBE: simple = tests on 2 criteria (coalescence, accuracy)
- AGENT: organised / user needs oriented = constraints
- CartoLearn: more complex ~ network of constraints assisted = KB automatically learnt
Splitting management

Number of nested splittings allowed

- GALBE: 2
  - 0 = initial road
  - 1 = bends series & isolated bends
  - 2 = bends inside a series

- AGENT & CartoLearn: as many as needed

Splittings only VS Splittings & mergings

- GALBE & CartoLearn:
  - splittings only
  - merging at the end

- AGENT:
  - merging after each splitting
  - allows successive splittings/ mergings
Choice of the next part of road to handle

• Between the different levels of splitting
  • GALBE & AGENT: depth first
  • CartoLearn: breadth first

• Inside one level of splitting: which one next?
  • GALBE & AGENT: coalescence criterion
  • CartoLearn: by chance
Choice of the next algorithm to apply

**GALBE**  
- Coalescence criterion + all previous operations  
=> too simple (complex cases)

**AGENT**  
- Choice of 1 constraint to solve  
- Choice of 1 algo proposed by this constraint  
=> acts to solve 1 given constraint

**CartoLearn**  
- Uses characters + last operation  
- Rule bases automatically learnt from examples  
=> takes all the characters into account
Validation & continuation

- Validation performed after applying an algorithm

<table>
<thead>
<tr>
<th>Check algorithm bug</th>
<th>GALBE</th>
<th>AGENT</th>
<th>CartoLearn</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

| Check accuracy      | ✓   | ✓     | ❌          |
| Check improvement   | ❌   | ✓     | ❌          |

- Stopping criterion

GALBE: limited number of steps
AGENT: perfect state reached or all solutions tried
CartoLearn: part of the learnt rules
Conclusion and perspectives

- Step by step, local approach confirmed
- Coalescence criterion = pertinent
- Efficacy / Complexity compromise
- Machine learning = tool to provide robust rules

Further work needed on…
- Missing measures: granularity, shape degradation
- Assessment : what does better/good mean ?
- Integrating the context to guide road generalisation