The CartACom model:
a generalisation model for taking relational constraints into account

Cécile Duchêne
IGN France - COGIT Laboratory
This presentation in the context of AGIT

AGIT:
COGIT laboratory's platform for research and studies in generalisation
Context: the AGENT model [Ruas 1999; AGENT 2001]

Geog. objects modelled as agents

I am an agent

And so am I
Context: the AGENT model [Ruas 1999; AGENT 2001]

Geog. objects modelled as agents
guided by constraints

I should be less detailed,
I should be more squared,
I should keep my global shape,
...
Context: the AGENT model [Ruas 1999; AGENT 2001]

Geog. objects modelled as agents
guided by constraints
"meso" level of analysis
Limits of the AGENT model

In rural areas:
- No natural hierarchy
  ⇒ no obvious meso
- Geog. themes are more various
- Conflicts are more local
  more various
Objective:

Propose a generalisation model based on transversal interactions between agents.
Objective:
Propose a generalisation model based on transversal interactions between agents.
Principle 1: Consider relational constraints

A cartographic constraint can concern:

- An object
- A group of objects
- A relation between two objects: relational constraint

Legibility

- Symbol overlap
- Near parallelism
- Near alignment

Preservation of relations

- Alignment
- Relative position (at the end, on the right)

Geographic coherence

- Serving
Principle 2: agents see and communicate

**Perception**

The building is overlapping me. There is free space above myself.

I am overlapping the yellow dead end. I am stuck because of the red road.

**Communication**

I cannot!

Move away!

The building is overlapping me. There is free space above myself.

It is stuck. Thus I'll try and change a bit my shape...

Much better!
Main novelties in the model since last year

- A generic model to represent the relational constraints
- A generic behaviour of the agents, guided by their relational constraints
- Two new generic operations:
  - Self-elimination
  - Propagation of deformations to the topologically connected agents
Modelling relational constraints

**Agent**
- priority : integer
- compute_priority()
- compute_proposals()
- re-evaluate()

**Relation**
- current_value : real
- goal_value : real
- satisfaction : integer
- importance : integer
- compute_current_value()
- compute_satisfaction()

**Constraint**
- constraint

Context and Objective

- APPROACH
  - CONSTRAINT MODELLING
  
**Example**

**Conclusion**
Modelling relational constraints

**Agent**

**Constraint**
- current_value: real
- goal_value: real
- satisfaction: integer
- importance: integer
- priority: integer
- compute_proposals()

**Relation**
- current_value: real
- goal_value: real
- satisfaction: integer
- importance: integer
- compute_current_value()
- compute_satisfaction()
- compute_priority()
- compute_proposals()
- re-evaluate()

**Constraint**
- priority: integer

**AGENT model**

**CartACom model**
Use of relational constraints

**List of possible actions**

<table>
<thead>
<tr>
<th>Constraint</th>
<th>Who acts</th>
<th>Algorithm</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>contrainte1</td>
<td>me</td>
<td>algo1</td>
<td>param1</td>
</tr>
<tr>
<td>contrainte2</td>
<td>the other</td>
<td>algo2</td>
<td>param2</td>
</tr>
<tr>
<td>contrainte3</td>
<td>me</td>
<td>algo3</td>
<td>param3</td>
</tr>
</tbody>
</table>

- Apply a generalisation algorithm to oneself: name, [parameters]
- Ask the other agent to apply a generalisation algorithm to itself: nom, [parameters]
Working example

- Hamlet *Les Boyers* (close to Aix-en-Provence)
- 49 handled agents:
  - 9 roads
  - 1 footpath
  - 35 buildings
  - 4 topological faces bounded by networks
- 19 "following" agents
  - 2 hedges
  - 17 land use parcels
- Some data on execution
  - Execution time: 63s
  - 178 activations of agents
  - 431 conversations: 37 requests for action, 394 information
Working example

• Considered relational constraints:
  – Non overlapping
  – Preservation of relative position (road-building)
  – Exaggeration of parallelism (road-building)

• Used operations
  – Buildings: displacement, rotation, self-elimination
  – Roads and buildings: internal generalisation (AGENT plug-in)
Other results - high density of buildings

Scale 1 : 35 000
Other results - high density of buildings

Scale 1 : 35 000
Other results - high density of buildings

Scale 1 : 50 000
Other results - high density of buildings

Scale 1 : 50 000
Other results - low density of buildings

Scale 1 : 50 000
Other results - high density of buildings

Scale 1 : 50 000
Conclusion

I can see myself
Conclusion

AGENT

AGENT - meso level

I can see myself
I obey to my boss
Conclusion

AGENT

AGENT - meso level

I can see myself
I obey to my boss

CartACom

I can see my neighbours and talk to them
Conclusion

AGENT

AGENT - meso level

I can see myself
I obey to my boss

I can see my neighbours and talk to them
I can see myself

CartACom
Next steps

Combine the AGENT and CartACom models

Handle internal and relational constraints in a combined way
Next steps

Combine the AGENT and CartACom models

Handle internal and relational constraints in a combined way

Use a group treatment during a CartACom activation
Combine the AGENT and CartACom models

Handle internal and relational constraints in a combined way

Use a group treatment during a CartACom activation

And the contrary
Next steps

AGIT:
COGIT laboratory's platform for research and studies in generalisation

GIS
LAMPS2
MEvaGeK
Evaluation of generalised data
URBA
Analysis of urban data
MAACOL
Assistance for knowledge acquisition
CartACom
Cartographic generalisation with communicating agents
AGENT
AgeCo
Additional developments
COGIT and IGN projects
COGIT LIBRAIRIES
CONCLUSION
Next steps

AGIT :
COGIT laboratory's platform for research and studies in generalisation

Thank you!
Questions?
Modelling relational constraints
Perspectives (2)

To go further

In the AGIT platform…
- **AGENT** + [Trévisan 04]
- **AGENT "meso"** + [Boffet 01]
- **CartACom**
  - [Galanda 03]
  - [Bader 01]
  - [Harrie et Sarjakoski 02] …

Combine approaches for a complete process

Introduce des constrained elements (relief)

Help to parameterisation of the result [Hubert 2003]
of the process