Cartolis: vers un outil géomatique pour identifier et caractériser les segments de lisières forestières
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CARTOLIS: towards a geomatic tool to identify and characterize the segments of forest edges

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Importance of forest edges

- Forest edges are **key elements of landscapes** (habitats and resources for many animal and plant species).
- Edges are very **diverse and have consequences** on the biodiversity and land management.
- The ecologists can apprehend this diversity at local scale or around a wood but not at the landscape scale → **question to the geomaticians**

Extract of land cover map (SPOT5; Barrussaud, 2008).
How to localise and quantify the diversity of forest edges at a landscape scale?

- To search for or to create a tool to take into account the diversity of edges, on a large spatial extent.
- **CARTOLIS**, to build a geomatic tool to meet ecologists needs to identify and characterize edges.
- **Line** = choice of the data model of CARTOLIS
  “the edges are then seen like a set of segments”.
Conceptualization of the method

- Combination of preexistent tools with an adaptation of script
- Installation and test of **model of treatment**

**Phase 1:** Identification of the edges in the landscape

**Phase 2:** Creation of the segments of edge

**Phase 3:** Characterization of the segments

**Sequence of operations** (including inputs, outputs, and parameters of treatment) **with methodological choices and formalization of the questions of ecologists**
Phase 1: Identification of the edges

How to separate the edges on an image?

- Localization of the edges using software GUIDOS. Why?
  - Graphical User Interface for the Description of image Objects and their Shapes
  - Standard Tool for characterization of forest fragmentation, created by the EU
  - Open source
  - Allows to distinguish in a landscape from broad extent, the class of the edges but in an undifferentiated way

**Input data:**
binary image
wood/not wood

**Output data:**
classified image of the various wooded elements in 7 classes

MPSA
with Edge width=20m (2 pixels)

http://efdac.jrc.ec.europa.eu/guidos
Phase 2: To identify the segments of edges

How to approach the perception of the ecologists by building rectilinear edges?

- Two important steps:
  - Simplification of the contour of wood
  - Extraction of the segments of edges

**GENERALIZATION:** Use of the function “Generalize” (ET GeoWizards):
- Douglas-Peucker algorithm:
  *Simplification of the shape of the polygons by reducing their number of sides while preserving their topology*
- Parameter of tolerance (T)

Polygon

Tolerance= 20m
= edge width

Raster To Vector
GENERALIZATION
SEGMENTATION
Phase 2: To identify the segments of edges

How to cut out the edges by keeping genealogy?

- **SEGMENTATION**: Use of the function “Split” (ET GeoWizards):
  - Algorithm of segmentation
  - Split in all vertices
- Logical LABELLING:
  - Array of pairs of co-ordinates
  - Concatenation of identifiers
Phase 3: Characterization of the segments

- **Calculation of attributes**, saved in database
  - **Intrinsic variables** on the segment
  - **Extrinsic variables** from other dataset

- Choice of a new objet= **Transect** and interrogation by spatial jointure
  - In conformity with methodological choices in Ecology where many studies are based on transects
  - Allows to cross with Raster or Vector data

- **Use of script “PerpendicularLine” (ESRI Inc):**
  - Parameter setting in language python

TRANSECT=Perpendicular at the central point of each segment, Directed outside wood, length=40m
Phase 3: Characterization of the segments (2/2)

- **Cardinal orientation (OC):** Intrinsic; continue (0 to 360°)
  - exposition of the edge compared to wood to which it belongs

- **Slope orientation (OP):** Extrinsic; discontinuous (3 Cl.)
  - Use of the MNT (TOPO database, 25m)

- **Land Cover occupation (OS):** Extrinsic; discontinuous (11cl.)
  - Use of the land cover map (INRA, 10m)

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All calculated indices depend on the grain (MNT 25m) and typology (11 classes of land cover)
- Definition of an original symbology

*CartolisSymbol*
### Statistical results from CARTOLIS

#### Quantification tool: on ~200km²:

<table>
<thead>
<tr>
<th>Phases</th>
<th>Process</th>
<th>Statistics</th>
</tr>
</thead>
</table>
| 1      | Classification | Water = 13,38%  
crop = 34,72%  
Meadow = 32,24%  
bareground = 10,3%  
Other = 0,63%  
Core = 8,77%  
**Edge = 4,61%** |
| • Treatment under Guidos: analyze morphological MPSA | Other wooded elements = 8,74% |
| 2      | Vectorization | 109 woods  
11,194 edges |
| 3      | Generalization | 101 wood  
4921 edges |

| 3 | Calculation of the variables | OC = Southern in maj.  
OP = no slope in maj.  
OS = meadow in maj. |
Statistical results from CARTOLIS

- Wood have an average surface of 20 ha and an average perimeter of 1.9 km
- 197 km of segments of edges in our landscape
- The average length of a segment is 40m
- Density of the segments of edges $= 1\text{km/km}^2 \rightarrow$ very fragmented landscape compared to the national statistics
- “South/no slope/Meadow”: the most current combination with 8.8 km of cumulated edges
Cartographic results from CARTOLIS

- Visualisation tool

zoom for effective symbology for scale <1: 10000

Interconnection between wood
Conclusions

• **Construction of a method for 2D analysis** with functional (geomatic aspect) and relevant (ecological aspect) outputs.

• **Adaptability of the developed method** with explanation of implementation detail of each phase (parameter setting, choice of the variables).

• **Improvements**: computing time, determination of the relevant parameter setting via integration the sensitivity analysis; IHM.

• **Prospects for comparative applications** between sites of long-term studies (synchronous approach).
Contribution to Landscape Ecology

- Participation to the definition of **new metric based on the segments**
- Complementarity with metric based on the polygons (Patch metrics Fragstats)

*Utilities of edge-based metrics for studying landscape fragmentation*

Hui Zeng a, X. Ben Wu b,*

Computers, Environment and Urban Systems
29 (2005) 159–178
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