Creation of Fiat Boundaries in Higher order Phenomenon

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Structure

In Essence: Spatial data mining approach for identification of implicit boundaries of higher order objects (1:250,000) from large scale spatial database.

Outline:

• Introduction: Importance of Boundaries
• Proposed Approach
• Implementation and Results
• Utilities & Conclusion - Why is this topic worth pursuing
Introduction

• Boundary
  – The line or plane indicating the limit or extent of an object or entity
• Boundary of building, city, mountain, forest
• Dependency between scale and boundary
• Why- Spatial analysis or Cartographic purposes
Types of Boundaries

• Bona-Fide Boundary
  – Spatial discontinuity

• Fiat- Boundary
  – Human cognition
Creation of Boundaries

• **Objective:** Create Fiat boundaries of higher order objects (1:250,000) directly from bona-fide and fiat objects at large scale (OS MasterMap 1:1250/1:10,000)

• Classes of Interest: City/Settlement, Forest, Hills, Mountain Range, Lakes/Reservoir

• Semantics
  – **Typicality** Members
  – **Good parts** (Merology)

  ![Diagram of Settlement Boundaries]

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Using Proximity (1)
Using Proximity (2)
Creation of Boundaries

• Clustering Algorithm (Chaudhry and Mackaness 2005)
Detection of Boundary (1)

- Limitations
Detection of Boundary

- Limitations
Gravity Model

• **Sir Isaac Newton**
• Law of Gravity “Every Object attracts every other object, this force decreases with distance”
Approach: Gravity Modelling

\[ g_i = \sqrt{a_i} \times \sqrt{\sum_{d \leq 100} a_n} \]

Gravity Classification
- 0.00002 - 0.03301
- 0.03302 - 0.05159
- 0.05160 - 0.09246
- 0.09247 - 0.25841
- 0.25942 - 0.53407
Approach: Expansion and Contraction

\[ t_i = k \sqrt{g_i} \quad (2) \quad \text{provided} \quad t_i \leq k \]
Approach: Aggregation or Elimination
Implementation

• Oracle Spatial 10g and JTS

CREATE INDEX: Creates a spatial index
SDO_GEOM.SDO_DISTANCE: Computes the distance between two geometry objects.
SDO_GEOM.SDO_BUFFER: Generates a buffer polygon around or inside a geometry object. Used for contraction/expansion.
SDO_AGGR_UNION: Returns a geometry object that is the topological union (OR operation) of the specified geometry objects. Used for aggregation of polygons
SDO_GEOM.SDO_AREA: Returns the area of a two-dimensional polygon.
SDO_UTIL.EXTRACT: Returns the geometry that represents a specified element (and optionally a ring) of the input geometry. Used for removal of holes/islands from a polygon.
Fiat Boundaries - Results

- Fiat – Settlement Objects

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Fiat Boundaries - Results

- Fiat – Settlement Objects
Fiat Boundaries - Results

- Fiat Forest Objects
Fiat Boundaries - Results

- Muller and Wang (1992)
Utility

• Input for Cartographic Generalisation: Displacement, smoothing, simplification for the creation of carto-symbols

• Determination of Partonomic Relations of source objects in terms of the target higher order object. Useful for spatial analysis and object modelling in cartographic domain.

• Dealing with fuzziness in terms of certain-interior, core and certain exterior. Application of 3 Value Model or Egg-Yolk Model.
Conclusions

- Identification of Noises by: Grids and Road Networks
- Richer getting Richer and Poor getting poorer
- Density + Area + Proximity promises to give better solution
- Discerning pattern, measuring it, accounting for it - lies at the heart of spatial analysis
- Application of this approach for determination of extent of hills or mountain ranges
References

