Object-based and geo-spatial image analysis: a semi-automatic pre-operational system

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Introduction

Context
Spatial reasoning:
- Spatial relationships graph
- Object recognition = isomorphism
- Both local and structural

Goals
- Complete processing chain
- Supervised
- Adapted to PHR imagery
- Validated with ORFEO DB
Outline

OBIA and active learning

Geo-spatial analysis
Object Based Image Analysis

Principle

- Primitive: region, not pixel
- Regions come from a preliminary segmentation step
- Attributes are associated to each region

RCC8 spatial reasoning graphs were already some sort of OBIA!

The preliminary segmentation step

- Preprocessing: smoothing, sharpening, rescaling
- MeanShift algorithm (few parameters)
A word about implementation

**LabelMap (InsightJournal)**

- Run Length Encoding for each region
- Associative container (*map*) to store regions
- Generic attributes dictionary

**Available attributes**

- Geometric: surface, elongation, *Flusser* moments
- Statistic: Mean, variance, *skewness*, *kurtosis*
- Radiometric: bandes spectrales, NDVI, NDWI2, BI...

A total of 53, easily extendable!
OBIA and classification

Goal

- Give a meaningful class label to each region
- More pertinent structural analysis

Classification

- Supervised classification based on attributes
- SVM Algorithm + cross-validation + parameters optimisation
- Important: normalizing attributes speeds up SVM
Results

Original image (Massif des Maures)
Results
Segmentation
Results

Object-based classification
Including spatial Context

Problème
How to account for neighboring regions during classification?

Proposed solution

*Bag of Neighbours*:

- Unsupervised clustering of the whole training set
- Neighborhood attributes: density of neighboring clusters
Results

Without context (left) and with context (right)
Object-based classification application

Overview
OBIA and Active learning

Goal

Iterative build of the training set:
- Without redundancy
- Complete
- Limited size

Less samples but more pertinent ones = less tedious

SVM and Active Learning

Margin Sampling technique (lots of variants):
1. Learning
2. Select samples closest to the hyperplane
3. Label these new samples
Object-based classification application

Active learning
Outline

OBIA and active learning

Geo-spatial analysis
Massive OBIA and GIS

Problem
How to use this method on a whole scene?

Solution
1. Scene tiling
2. Tiles segmentation
3. Object-based learning on selected tiles
4. Object-based classification of each tile with PostGIS export

Data representation in PostGIS: region (polygon) + attributes + class
Viewing PostGIS tables in QGIS
Geo-spatial analysis
Exploiting PostGIS capabilities

- Huge amount of data
- Simple language
- Attributes filtering: greater than, lower than, between . . .
- Spatial requests: convex hull, intersection, surface, position, proximity . . .
- Results can be persisted into a new table
Example

Where are bridges?
Example
Where are bridges?
Example
Local red roofs density
Example
Locating towns
Conclusion et perspectives

Conclusion

- Full chain, almost operational
- Supervised
- Flexible approach: tuning classes and attributes
- State-of-the-art tools: SVM, Mean-Shift, Active-Learning, OBIA, GIS ...

Perspectives

- Lots of possible improvements
- Need a common classes specification
- Geo-spatial capabilities must be further investigated