High resolution remote sensing image analysis with exogenous data

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Outline

Image analysis

PhD thesis framework

Example of instantiation

Conclusion

Future prospects
Ideal goal of image analysis: Obtaining quickly and automatically an image interpretation specific to each application.
High resolution satellites

- Optical / Multi-spectral
  - SPOT5: 2,5m
  - Pléiades: 0,7m

- Radar (SAR)
  - Terrasar-X: 1m
  - Cosmo Skymed: 1m
  - Radarsat-2: 3m
Works on image analysis in literature:
- Often specific to one application and to one sensor
- Prior information rarely considered

Future prospects:
- Consideration of multi-sensor data
- Use of exogenous data like database, DEM, ...
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Foreseen data:
- Sensors: Pléiades, Spot5, Cosmo-Skymed, Terrasar-X, Radarsat-2
- Databases: IGN BD Topo, Urban DB, Scanned maps
- Several possible scenarios according to available data

Information extraction:
- Selection of relevant data
- Possible use of database
- Object extraction

Change detection
Figure: Proposed processing chain
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Chosen processing chain

HR SAR Sensors
Optical/multispectral HR Sensors
Filtering
Information Extraction
Registration
Change detection
Relevant feedback
Database Creation / Update

- Optical Image (Pléiades)
- 2D Vector DB
- Image comparison
Figure: Main processing steps
Database representation

- Use of Urban database in DXF format
- Rasterization
Optical image processing

- Panchromatic image
- Watershed segmentation
- Kohonen self organizing map classification
Figure: Watershed algorithm principle
Figure: Saint-Michel district after anisotropic filtering

Figure: Segmentation thanks to watershed algorithm
**Figure:** Saint-Michel district segmentation after simplification

**Figure:** Polyline representation
Classification

Classification thanks to Kohonen’s Self Organizing Map.

Parameters for classification:

- Mean length between two vertices
- Maximum segment length in the polyline
- Difference between simplified polyline and original polyline
- Variance between right angle and angles in the simplified polyline
- Flusser moments
Figure: Result of the classification

Figure: Segmented raster image
Change detection

Figure: Registration of database and raster image
Figure: Saint-Michel district: database

Figure: Result of the classification
Use of Danielsson distance maps:

Figure: Distance map of the database

Figure: Satellite image distance map
Tested methods:

- Change detection by subtraction between distance maps
- Change detection by correlation
- Change detection by integration of database distance map along each polyline
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**Figure:** Reference database

**Figure:** Addition of 4 buildings
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Figure: Test of building addition with correlation method

Figure: Test of building addition with subtraction method
Figure: Saint-Michel district: database

Figure: Result of the classification
Figure: Change detection result using correlation method

Figure: Change detection result using subtraction method
Figure: Superposition of polylines on database distance map

Figure: Change detection result using integral along polylines
Conclusion

- Crucial importance of segmentation in this approach
- Use of multi-spectral information to improve segmentation result
- Possibility to combine several change detection methods
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Figure: Multi-sensor data registration
Figure: Use of generic processing methods
Figure: Use of the database to guide image analysis
Figure: Choice of representation level
**Figure:** Uncertainty modeling
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- Multi-sensor data registration
- Use of generic processing methods
- Use of the database to guide image analysis
- Choice of representation level
- Uncertainty modeling