Information Mining from Remote Sensing Imagery Based on Multi-scale and Multi-feature Processing Techniques

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Outline

1. Background
2. Methods
   - Flow for remote sensing data mining
   - Multi-scale image segmentation
   - Multi-feature computation
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1. Background

- Huge **quantity** of remote sensing imagery can be obtained by now, and the quantity is still growing in rapid speed.

- However, decision makers still lack ready to use **geo-information** for resource and environment management to support sustainable development.
1. Background

- Traditional method for information extraction is by \textit{manual interpretation}.

- It can reach reasonable \textit{accuracy} when interpreted by well trained expert,

- but it is \textit{time consuming} and different people may interpret \textit{different result}.
1. Background

- Nowadays, The goal of image analysis and information extraction:
  - **Automatic** procedure
  - Reasonable **accuracy**

- The development of **OBIA** (object based image analysis) technique provide promising approach to reach the goal of intelligently and **automatically** image information extraction.
1. Introduction --- About OBIA

OBIA (object based image analysis)

- Review article:
  Object based image analysis for remote sensing, Blaschke, 2010.

- Benz et al. (2004)
- Burnett and Blaschke (2003)
- Baatz and Schape (2000)
- Blaschke and Strobl (2001)
- Hay and Castilla (2008) ....
  : GEOBIA paradigm shift for image analysis

Researchers, application fields
1. Background

This paper:

Under the framework of OBIA, this research intend to develop an remote sensing information Miner based on multi-scale and multi-feature processing technique.
2. METHOD
2.1 Remote sensing data mining framework

- 1. Image complexity computing
- 2. Big region segmentation
- 3. Fine scale segmentation
- 4. Object primitive multi-feature computation
- 5. Object classification
Multisource multiresolution images

Image complexity computing

Big region segmentation

Sea / Land  Mountain / Plain
Water / Land  Urban / Rural

Segmentation in fine scale

Region primitive

Primitive multi feature extraction and analysis

(edge, shape, color, texture, context, ...)

Clustering, classification, feature mapping
(based on multi-feature)

(regional water, settlement area, tidal flat, water line, linear water, road, land use, sea wall, ...
2.2 multi-scale segmentation

(1) Segmentation:
- Fast watershed segmentation

(2) Merger:
- Fast and repeatable merger:
- Spectrum and shape features are used for scale parameter computation
2.2 multi-scale segmentation

*Algorithm parameter (scale, spectral, shape..)*
*Multi-spectral images*

*Principal component analysis (PCA)*
*Weight coupling relations*

*Fast watershed pre-segmentation*

*Primary divisional plots (sub-primitive)*

Accuracy evaluation
Results output

*The minimum merger cost greater than the square of scale parameter*

Feature measuring (spectral mean and variance, shape smoothness, compactness and topology)

Calculating and sorting the cost of primitive merging

Fast primitive merging
Effect of image segmentation

Scale: 10

Scale: 20

Scale: 100

Scale: 200
2.3 Multi-feature computation

- Spectrum feature
- Shape feature
- Texture feature
- Spatial relationship feature
Spectrum features

(1) Spectrum statistical features
   Mainly includes some statistical index such as mean, variance, histogram, and so on.

(2) Spectrum computational features
   Mainly includes arithmetic operations between different bands spectrum in the same images, such as NDVI, etc.
Shape features

(1) Extent features:
   area, perimeter, width, thickness, length ...

(2) Directional features:
   principal axle direction.

(3) Fractal features:
   fractal dimension, fractal index,
Texture features

Texture can be used to describe the grey value distribution features for images:

(1) Texture after Haralick:
   based on the gray level co-occurrence matrix (GLCM)

(1) GABOR filter texture

(2) LBP texture
GIS Spatial relationship features

Mainly construct the topological relationship between image objects, as well as image object spatial orientation information.

For example, take DEM as a constraint of terrain features, and take the distance away from the coastline as a constraint features and so on.
3. EXPERIMENTS
3. Experiments

- Aiming at applying the information extraction technique for coastal research, and supporting resource investigation and environment monitoring by remote sensing approach.

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<th>Features and Parameters</th>
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<td>DN, area, edge feature</td>
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<td>Hue, squareness</td>
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3.1 Water Line Information

Data:
SPOT
2.5m imagery

Features:
DN, area, edge feature
3.2 Seawall Information

Data:
SPOT
2.5m imagery

Features:
Brightness, ratio of length to width
3.3 Tidal flat Information

Features:
DN, area, distance to water area

Data:
SPOT
2.5m imagery
3.4 Aquaculture Information

Data:
IKONOS
1m imagery

Features:
Hue, squareness
4. CONCLUSION
CONCLUSION

1. As high resolution remote sensing technique developing, traditional pixel based image analysis cannot meet the accuracy demand of application communities.

   In addition, with rapid growing of remote sensing data quantity, the traditional manual interpretation approach do not meet the quickly mapping demand of application communities.
2. The object based image analysis approaches provide good potential to bridge the gap, and the approach developed in this research show good applicability for geo-information extraction from high resolution imagery.
Thanks for your attention