An Automated Object-Oriented Satellite Image Classification Method Integrating the FAO Land Cover Classification System (LCCS).

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PRESENTATION SCHEDULE

Justification

Objectives

Background

Study area and data preprocessing

Methodology

Results

Classification
Automation
Application on other data types

Conclusions and future research directions
demand for tangible landscape objects at several scales which are internally relatively homogeneous on which one can apply spatial statistics and assess changes.

classification quality is directly dependent on the quality of extracted objects or pixels.

object-oriented image classification is based on the fact that important semantic information necessary to interpret an image is not represented in single pixels, but in meaningful image objects and their mutual relations.

Recent applications of image understanding techniques require increased robustness, better reliability and high automation of the algorithms.

In Land Use and Land Cover (LULC) studies automation of the classification process reduces the time input into technical analysis thus making more processed data available to end-users and decision makers.
OBJECTIVES

To develop a standardized, object-oriented classification method, with automation capabilities.

• develop a method based on linking object-oriented image analysis with the FAO Land Cover Classification System.

• test the automation capabilities of this technique on other same-sensor/date images.

• apply the method on different satellite images.
Multi-resolution Image Segmentation (MS)

MS is a patented procedure for image objects extraction, allowing the segmentation of an image into a network of homogeneous image object primitives at any chosen resolution.

MS is a bottom-up region-merging technique starting with one-pixel objects, smaller image objects are merged into bigger ones.

Object-Oriented Image Analysis

Image object primitives serve as building blocks and information carriers for subsequent classifications.

- **intrinsic features** - colour, texture and form of objects.
- **topological features** - geometric relationships between the objects or the whole scene - left, right, or being in a certain distance to a certain object.
- **context features** - objects' semantic relationship e.g. a park is almost 100% surrounded by urban areas.
a. Segmentation with scale parameter: 15
b. Segmentation with scale parameter: 21
c. Thematic layer - Cadastral information
d. Final classified objects
Basic Concepts of the FAO LCCS

Comprehensive methodology for description, characterization, classification and comparison of most land cover features identified anywhere in the world, at any scale or level of detail

Created in response to a need for:

- A harmonized and standardized collection and reporting on the status of land cover

- Availability of land cover data for a wide range of applications and users

- Comparison and correlation of land cover classes between different systems/approaches
The LCCS is based on a standardized *a priori* classification system - classes are defined before any data collection actually takes place.

The advantage is that classes are standardized independent of the area or means used.

All land covers can be accommodated in this highly flexible system;

serve as a universally applicable reference base for land cover and land use derived from satellite imagery.

contributing towards data harmonization and standardization.
Class Levels in the Classification Hierarchy.
Feature Selection

• Spectral Information
  - mean
  - standard deviation
  - ratio
  - brightness
  - minimum & maximum values

• Shape
  - area
  - compactness
  - rectangular fit
  - density
  - shape index.

• Relational Features

• Texture (Texture after Haralick)

• LCCS Classifiers
  - cover
  - water seasonality
  - leaf type and leaf phenology stratification or layering and spatial distribution (macropattern) classifiers
Perform feature selection and threshold values for splitting classes

If field data is present, use known objects to select feature threshold values

Perform class-related classification for two classes at any time

Analyze result, if misclassified objects are present, then go back to threshold refinement

Final classified image & legend produced with same LCCS class names.

Save final protocol and class hierarchy for use in automation

Other Image Processing Software

Perform color matching if necessary for same-day objects

Perform radiometric normalization if multi-temporal objects

Automation

Import georectified Image

Load class hierarchy & execute protocol

x - images classified

Accuracy Assessment

Figure 1. Synopsis of the Method
Field Reconnaissance

• High quality training data are essential for accurate land cover classification of any sort.

• To insure high spatial and thematic precision of collected data, field sampling was conducted in a GIS framework.

• For each point, species composition, level and type of management, soil characteristics, topography, forest layers and canopy characteristics were collected.

Object Verification

• Objects were selected systematically based on the use of road transects. At every 20 km point along major roads then identified on the image.

• Objects extracted from the image were then verified in the field.

• Threshold determination - objects with different feature values (e.g. NDVI values) were used to conclusively determine the threshold values.
Fig. 2a-b. Dichotomous and modular-hierarchical level classification of the ASTER image.
Fig. 4. Classification of an individual object: Final Class Name - Open (40 - (20-10) % Forest (Woodland).
AUTOMATION

Preliminary Steps

- Image geo-rectification
- Colour matching
- Sun elevation adjustments

Scale parameter of 8

ASTER image taken x sec after base image

Scale parameter of 20
CONCLUSION AND FUTURE RESEARCH

• This technique produced highly distinct classes and class definitions are clear and unambiguous.

• It offers more capabilities due to the large number of classifiers and features available in both LCCS and eCognition, which can be combined.

• The method will be applied to other satellite data including IKONOS and SPOT images.

• Change detection employing this object-oriented and standardized approach is under investigation.

Thank you!