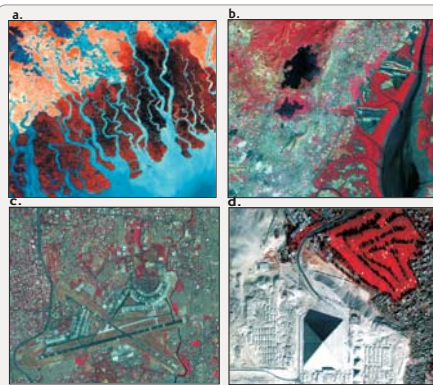


Satellite Image Processing & Analysis

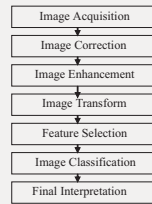
Digital Image Processing



Digital Image Processing

Remote sensing technology provides a synoptic view of a large area of the Earth's surface in a single image that facilitates identification of various types of natural resources and their status. Some of the sensors provide a broad view of a large area at a coarse resolution, while some sensors provide a detailed view of a small area. All sensors today provide the image data directly in digital form. Computational algorithms and software techniques together with the power of desktop computers enable efficient information extraction from these images by DIGITAL IMAGE PROCESSING techniques.

Fundamental Steps in Digital Image Processing



a. Very low resolution image.
b. low resolution image
c. Medium resolution image
d. High resolution image

Object based Image Analysis

Information in high resolution images is made up of objects that are characterized by

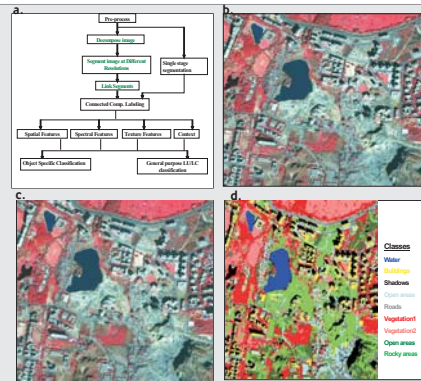
- Shape
- Size
- Color/spectral properties
- Texture
- Context

Object based image analysis is emerging as a new paradigm for analyzing high resolution satellite imagery. The major components of this analysis include

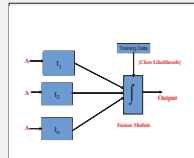
- Image preprocessing for noise suppression
- Region segmentation
- Region labeling
- Feature vector generation for the regions
- Region classification
- Post-classification refinement using context

Region classification also facilitates direct export to GIS databases due to the inherent handling of image as a collection of regions or polygons.

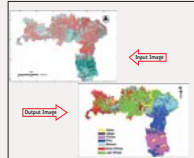
a. Generic High Spatial Resolution Image Analysis Framework.
b. Quickbird Window.
c. Region Segmentation.
d. Classification Results



Multi-Classifer Fusion



a. Classifier Fusion Strategy



b. Classified Images

Practitioners of remote sensing often deal with data sets from a collection of sensors, and a collection of software tools to process them. Several situations are often encountered in practice:

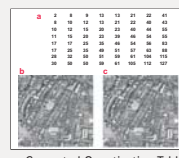
- One data set and one classifier
- One data set and several classifiers
- Multiple data sets and one classifier
- Multiple data sets and many classifiers

Integration of classification results is important because

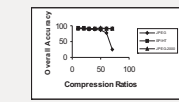
- The limitations of one data set are compensated by another data set
- The limitations of one classifier are compensated by another classifier
- Multiple data sets and classifiers can improve the overall accuracy of classification.

Sugeno Fuzzy integral method is a powerful tool for integrating multisource information. This method is adapted for fusing results of different neural networks applied to classifying multitemporal imagery.

Image Compression in Space Applications



a. Generated Quantization Table using Genetic Optimization
b. Input image
c. Compressed image



Comparison of classification accuracy of JPEG and JPEG 2000

Digital image compression for remote sensing is becoming increasingly relevant because the amount of data generated is increasing exponentially caused by:

- High spatial resolution
- Stereo coverage

Compression techniques are being applied for:

- Rapid onboard compression and downlink to ground stations
- Efficient compression and distribution over internet/intranet for browse and sharing purposes

Genetic algorithms were applied to adapt JPEG technique to rate-constrained image compression. Quantitative and application dependent evaluation of JPEG2000 technique was carried out from remote sensing perspective.

Ongoing Research Areas

Partially Supervised Image Classification

- Partial ground truth
- Estimation of missing class signatures using E-M method
- Performance evaluation as a function of statistical properties of missing classes

Hyperspectral image analysis

- Image corrections
- Optimal feature subset collection
- Pure pixel identification
- Mixture modeling
- Classification algorithms suitable for high dimensional data

Contextual Refinement of Classification

- Refinement of per-pixel Classification
- Contextual Classification of Objects
- Region/edge boundary fusion
- Improved label updating rules

Support Vector Machine (SVM) Classification

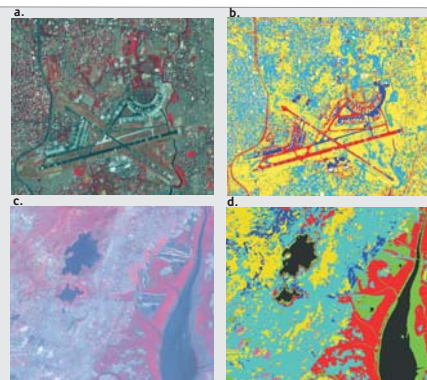
Popular classification technique in view of its ability to deal with:

- Sparse training data
- High dimensional data
- Nonlinearly separable data by transform kernels

In progress:

- Classification of hyperspectral imagery
- Classification of regions from segmentation of high resolution imagery
- Develop improved kernels

a. Original image IRS-P6 LISS-IV
b. E-M algorithm classification with signature estimated for two classes of image a.
c. Original Image for SVM Classification
d. Classification with RBF Kernel of image c.



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