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DEEP LEARNING WITH MULTIBAND SYNTHESIS FROM LANDSAT-8 SATELLITE IMAGERY USING MACHINE LEARNING

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Abstract

This research article proposes a novel deep learning representation and segmentation approach for moderate resolution remote sensing image analysis. A data extraction approach using deep hierarchical understanding for remote sensing image is adopted as a test bed for further increase in spatial resolution imagery. The idea is the fact that we can adopt a quick scanning image segmentation in a deep learning feature representation framework using a deep learning technique to produce reasonable sized clusters in segmented regions until it forms a super-object. Our contribution is to implement an effective procedure for multi-scale image analysis to address the issue of measuring uncertainty in practice.

We then propose to test our method on two high resolution remote sensing image datasets that will output results in the form of multi-layered scenes that attest the efficiency and reliability of our proposed system.

Key words: Hierarchical Scale Space, Hierarchical Image Analysis, Scene Segmentation, Deep learning, Convolution Neural Networks, Satellite Imagery.

Introduction

Feature Selection for scene analysis is vital for feature object understanding that is very crucial for scene recognition that has been a focus of a lot of research studies on feature extraction from high resolution remote sensing images. Feature extraction delineates the objects into simple regions with homogeneous classes for the proper layout of image contents. It is therefore a great challenge in computer vision and pattern recognition for representation of features with accuracy and timeliness. Due to automation tasks in the process some geometries of the target objects are not delineated accurately which is then represented as uncertainty in final image analysis.

There exists techniques for feature selection from labeled and unlabeled images that will adopt the learned features to accurately train the classifier, which then can be used in feature extraction in the new classified images. There have been some recent developments in this area of research that factor in high-dimensional data like multi-spectral and high resolution satellite images. Recently, deep learning methods have generated models from unlabeled data that result in deep neural networks for object analysis and scene classification.

In this research article, we propose a method that produces hierarchical scale space images from input datasets that will be input to the segmentation method under deep learning framework.

Methodology

A feature extraction method using multi-scale and hierarchical representations of remote sensing image is described. We develop a quick scene segmentation and a deep hierarchical feature selection framework in order to develop an automated workflow for multi-scale remote sensing images to produce an efficient image analysis technique. The framework of our proposed strategy is shown in figure 1. The high resolution satellite image is pre-processed to produce over-segmentation with fuzzy learning rules with clustering. Then a Region Adjacency Graph of the segmented scene is produced hierarchically in a deep learning framework. The multi-scale feature understanding is constructed to output a set of object segmented scene.

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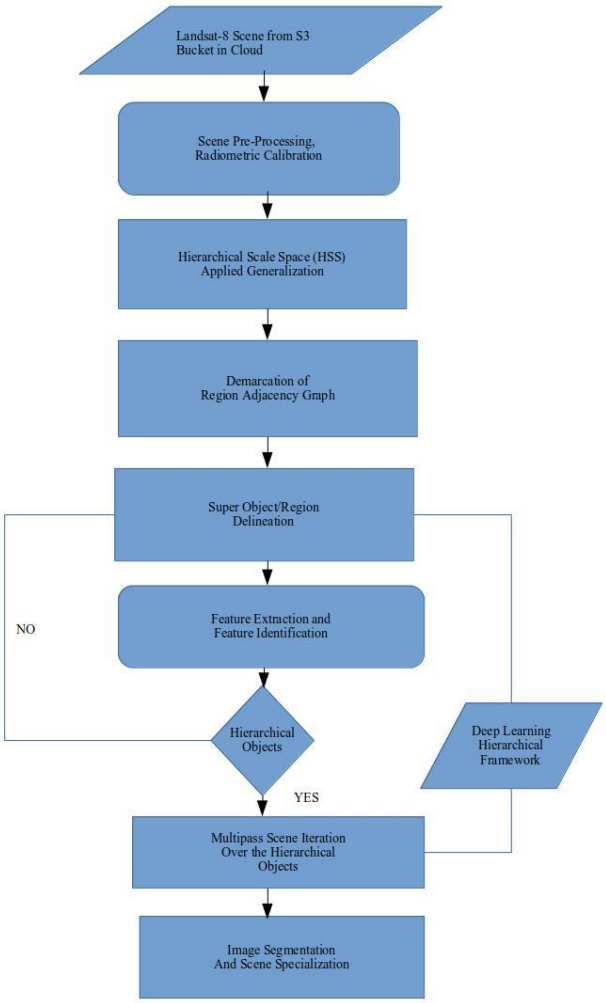

Figure 1: Proposed Hierarchical Framework Methodology

Proposed Algorithm

i) Hierarchical scale space produced images of a typical scene are produced to generate the apriori segments of super objects with varying sigma (scale parameter). Then, unlike region growing there is not a need of seed features for the initial super object classes that in turn is draped over the margins of feature boundaries from left-to-right corners of the image covering the entire scene. Feature delineation for merging and splitting is performed by Spatial Fuzzy C-Means clustering algorithm.

ii) Developing a Region Adjacency Graph (RAG) that relates to edge pixels provides a spatial view of the scene. The RAG process associates a vertex from each region with an edge in every pair of adjacency regions. The graph's element delineates a segment that the graph's edge represents as a path over two regions, preserving the image neighborhood objects.

iii) Feature extraction and merging from regions identified previously are merged again based on deep learning technique. The region merging procedure is a bottom-up process that extracts regions under certain criteria (spatially adjacent and similarity index). Region merging is based on Deep Neural Networks and feature learning in an unsupervised method. Feature splitting and merging is iteratively performed until final objects are extracted and represented.

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iv) The multiple layered feature extraction procedure is designed to output a set of hierarchically segments from input satellite imagery dataset. A unique aspect of this technique is that all edges are demarcated at the optimum spatial resolution of the imagery dataset. The segmentation levels are used for feature selection in the region of interest (Contouring).

The iterative process will be conducted on Landsat-8 scene of Chennai City with 30m spatial resolution (Figure 2) and dataset from Cartosat-2 scene with 2.5 m resolution.

As described above, scene resolution allows for simulating the scale of human vision to produce more and more detailed object hierarchies. The scene can be visualized by the analysis of adaptive scales according to the domain of selection. The unique representation is that this procedure relates to the concept of hierarchical image features that are significant at several scale levels.

Results

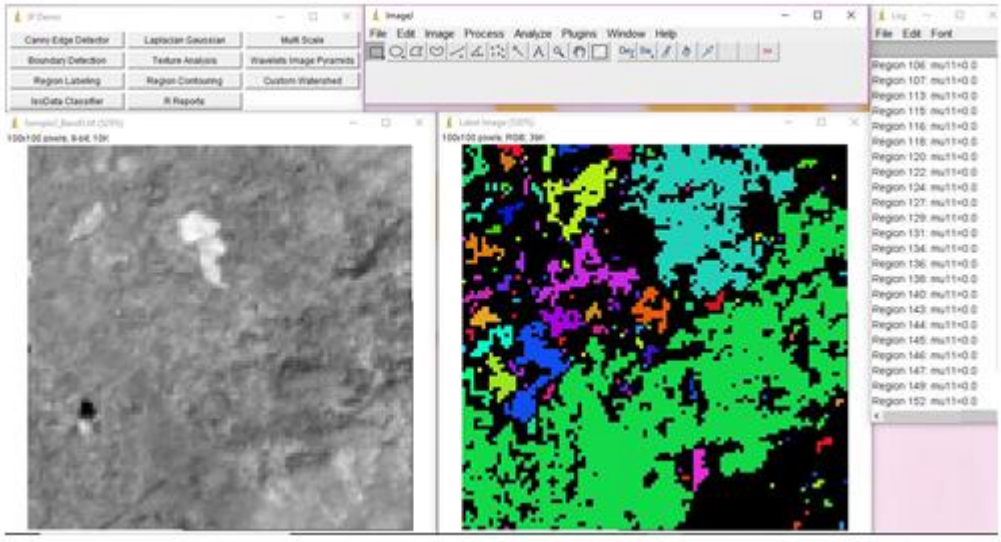

Figure 2: Region Labeling for Landsat-8 Scene (Hierarchical framework)

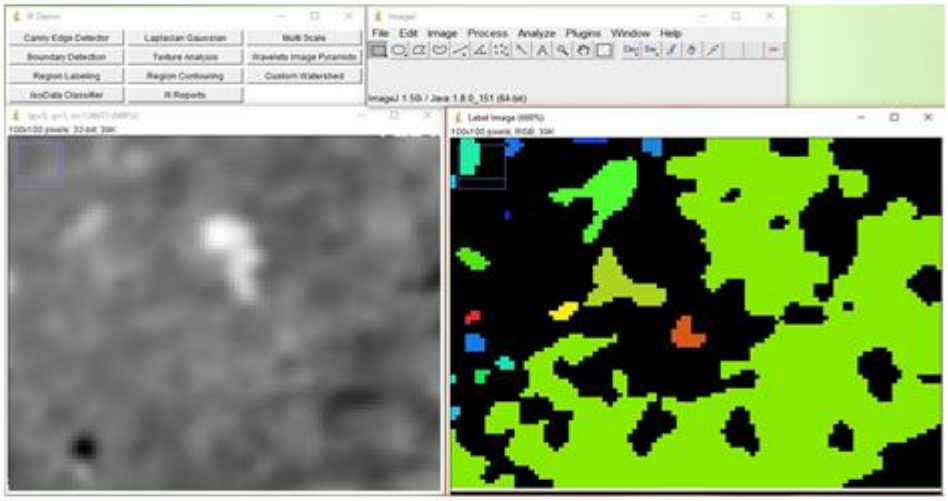

Figure 3: Multiscale analysis of Landsat-8 Scene with Region Labeling

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