HSegLearn – A Tool for Computer-Assisted Ground Reference Data Development

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Introduction

The Global Land Survey and Impervious Mapping Project (GLS-IMP) seeks to map impervious land cover globally at 30 m spatial resolution for the years 2000 to 2010 based on the Landsat TM Global Land Survey (GLS) data set. Ground reference data are needed to train and validate the decision tree classifier utilized to create the map, but sufficient ground reference data is not available from ground surveys.

Photo-interpretation of 1 to 2 m resolution satellite imagery can provide accurate 30 m resolution ground reference data when coarsened to that resolution. To make the photo-interpretation process more efficient, we developed the HSegLearn software tool, based on the existing HSeg software package.

The HSeg Software Package

The HSeg software package has been in development over the past decade-plus at NASA GSFC [1]. The main component of this package in the HSeg image segmentation program, which implements a variant of best-merge region growing.

The key difference between HSeg and other region growing implementations is HSeg's unique tight intertwining of region growing segmentation, which produces spatially connected region objects, with non-adjacent region object aggregation, which groups sets of region objects together into region classes.

HSeg produces a segmentation hierarchy in the form a set of several image segmentations at different levels of detail in which the segmentations at coarser levels of detail can be produced from simple merges of regions at finer levels of detail.

The HSeg software packages includes the graphical user interactive program HSegViewer [2] through which an analyst can visualize, manipulate and interact with the hierarchical segmentation results produced by HSeg. HSegViewer can be used to label selected region objects and classes at particular levels of segmentation detail from the HSeg segmentation hierarchy.

References

[1] J. C. Tilton, Y. Tarabalka, P. M. Montesano and E. Gofman, "Best merge region growing with integrated non-adjacent region object aggregation," *IEEE Trans. Geosci. Remote Sens.*, 50(11), pp. 4454-4467, 2012.
[2] J. C. Tilton, *RHSeg User's Manual: Including HSWO, HSeg, HSegExtract, HSegReader, HSegViewer and HSegLearn,* version 1.59, available via email request to James.C.Tilton@nasa.gov, Feb. 7, 2014.

HSegLearn

HSegLearn provides a convenient tool with which an analyst can label a particular ground cover class based on the hierarchical set of image segmentations produced by HSeg.

Through HSegLearn, an analyst selects region classes or groups of region classes as positive or negative examples of a specific ground cover class, with impervious surfaces being the class of interest for this project.

Based on the provided selection of positive or negative example region classes submitted, HSegLearn searches the HSeg segmentation hierarchy for the ***coarsest*** level of segmentation at which the submitted positive example region classes do not conflict with the submitted negative example region classes, and displays the submitted positive example region classes at that level of segmentation detail.

Through several iterations of submitting positive and negative region classes, an accurate labeling can be produced with relatively high efficiency.

Current Region Labels" display labels:

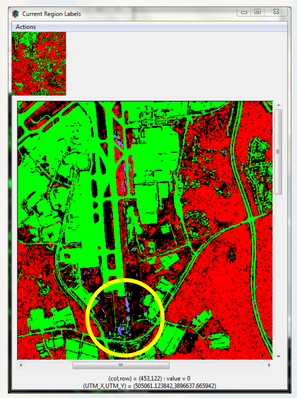
- **Green**: Submitted positive example region classes.
- **Red**: Submitted negative example region classes, always displayed at the ***finest*** level of detail in the HSeg segmentation hierarchy.
- **Purple**: Region classes submitted as both positive and negative examples by the analyst are labeled as "ambiguous" classes at the ***finest*** level of detail..
- **Black**: Unlabeled areas.
- **Yellow**: Selected areas not yet submitted.
- **White**: Highlighted regions prior to selection.

Using HSegLearn to Generate Ground Reference Data

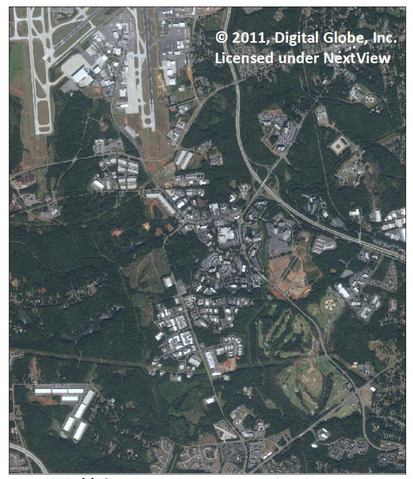
The RGB Image display panel. The image displayed is a subset of the WorldView2 image used in our study from Charlotte, NC, USA.

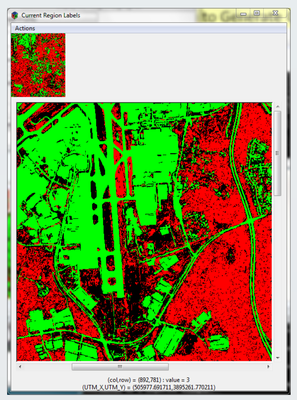
The Current Region Labels display panel after the analyst highlighted several positive example regions by clicking on several pixels in the RGB Image display panel.

Previously highlighted regions are selected (yellow). Groups of additional negative examples (white) are highlighted.

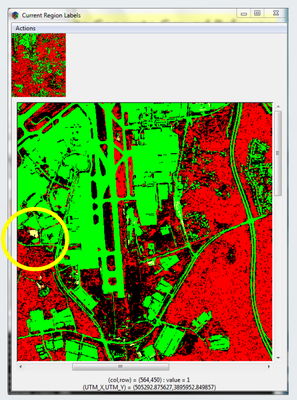


The result after submitting the positive and negative example regions.

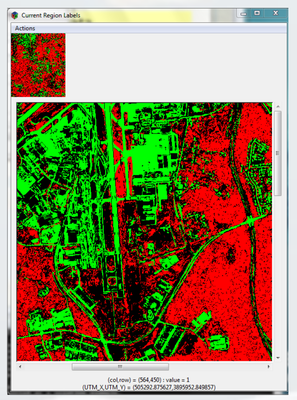




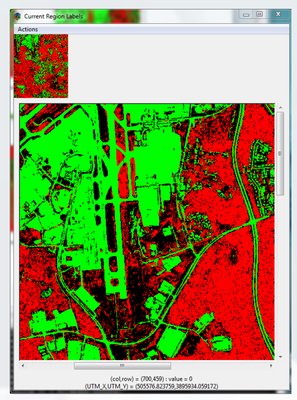
The result after ambiguous regions (circled in the previous panel) are selected and submitted as negative examples.



The result after the analyst selected a non-impervious region class that was mislabeled as impervious (circled).



The result after the mislabeled impervious regions were submitted as negative examples.



The result after the analyst selected and submitted several more positive example regions.