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WHITE PAPER

OBJECT-ORIENTED IMAGE SEGMENTATION AND CLASSIFICATION ALGORITHMS

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BerkeleyImgseg is an object-oriented image processing software package published by Berkeley Environmental Technology International, LLC. This white paper summarizes the image segmentation and classification algorithms found in the software.

Object-Oriented Image Segmentation

Capability: Define and extract image objects (polygons).

Input: Standard format image file with three channels. The size and shape of the objects is controlled by user selected parameters for shape, spectral variation and merging threshold.

Output: New image indicating segmentation of the input image by spatial decomposition into objects. Vector geometry (Shapefile) of the object boundaries with spectral and shape attributes.

Method: Pixel-based region merging utilizing spectral information, shape metrics (compactness versus smoothness), and a threshold object size. Objects are seeded and grown based on spectral similarity of adjacent pixels and if the object would meet the shape characteristics. Objects are then iteratively grown and merged based on these same parameters up to the threshold (maximum) given.

K-Means Cluster – Object-Oriented Image Classification

Capability: Unsupervised classification of objects in an image based on object intensity across all channels.

Input: Segmented image file with arbitrary number of channels. The number of classes.

Output: New image with the objects colored by class. Attribute table classifying each object.

Method: First calculate the average intensity for all channels of each object. Initial definition of each class is based on a random choosing of one object per class. Then assign each remaining object to the class for which the object's average intensity is closest to the class average. The assignments are then iteratively refined by recalculating the class-wide average and shifting objects between classes.

Online: http://en.wikipedia.org/wiki/Kmeans

K-Nearest Neighbor – Object-Oriented Image Classification

Capability: Supervised classification of objects in an image based on object intensity of each channel.

Input: Segmented image file with arbitrary number of channels. The number of classes and selection of training samples for each class.

Output: New image with objects colored by class. Attribute table classifying each object.

Method: For each object, calculate the "distance" of the average intensity of each channel to the average intensity for the same channel in each training sample. This creates an ordered list of how "close" each object is to each training sample in each class. The object is assigned to the class for which is has the most "closest" average intensities across the different training samples of that class.

Online: http://en.wikipedia.org/wiki/K-nearest_neighbor_algorithm

Neural Network – Object-Oriented Image Classification

Capability: Supervised classification of regions in an image based on spectral information in each object and a function shape for learning how to group objects.

Input: Segmented image file with an arbitrary number of channels. The number of classes and a selection of training samples for each class.

Output: New image with objects colored by class. Attribute table classifying each object.

Method: This is a three-layer fuzzy perceptron. The input layer has nodes for each object attribute chosen for classification. The hidden layer has a node for each rule. The output layer has a node for each class.

Online: http://en.wikipedia.org/wiki/Feedforward_neural_network