Land Cover Mapping with Hyperspectral Imagery

Hyperspectral Imagery Studied for Indications of Emerald Ash Borer Infestation

By Clark Labs

Clark Labs and the USDA Animal and Plant Health Inspection Service are currently analyzing hyperspectral imagery for indications of Emerald Ash Borer (EAB) infestation in Michigan and Ohio.

The emerald ash borer, an exotic wood boring beetle from East Asia, was recently found attacking ash trees in the metropolitan area of Detroit, Michigan. This buprestid species feeds under the bark of ash trees in its larval stages, girdling trees and killing them rapidly. Thousands of trees in southern Michigan and northern Ohio have already been killed by this highly invasive species. Left unchecked, it poses a very serious threat to urban and natural forests in the United States.

Survey for the beetle is difficult because it is already spread over a wide area, many ash trees and stands are inaccessible from the ground, and trees exhibit few outward signs of beetle attack until they are moribund. Working with personnel from the Pest Survey, Detection and Exclusion Laboratory of the Center for Plant Health Science and Technology division of APHIS, scientists from Clark Labs will develop algorithms for the classification of both healthy ash trees and those infested by EAB in hyperspectral imagery. Maps produced of the distributions of such trees will guide future ground surveys and potentially estimate dispersal rates of the EAB.

Collecting signatures of ash trees.

Hyperspectral imagery at 1 and 2 m resolution has already been acquired for two time periods in 2004, the first at the beginning of July and the second at the end of August. The data were collected for three locations in southern Michigan and two in northwestern Ohio using the HyperSpecTIR HST-2 whisk-broom scanner from SpecTIR, Inc. The 227 bands of data are fully calibrated in both radiance and atmospherically corrected reflectance values. Each pixel also includes its GPS-derived locational reference.

USDA personnel collected ground truth information along the flight areas in July, August and September. Using a Trimble GPS unit, they georeferenced ash trees in a number of sites and rated them as to the status and severity of infestation. Spectral signatures of healthy and infested ash trees were also collected with the Analytical Spectral Devices (ASD) FieldSpec Pro spectroradiometer. To duplicate reflectance conditions recorded by the airborne hyperspectral scanner, signatures were collected above the tree crowns with the use of bucket trucks.

Clark Labs' personnel are processing and analyzing the data. Images have been screened to remove bands exhibiting significant atmospheric absorption. As there is a massive volume of data (approximately 2700 swaths of 227 bands representing over 600,000 images), only a subset of the data has been initially georeferenced for the purpose of locating the ground truth sites and for visual support of the multispectral classification. Since georeferencing requires resampling, ultimately causing a spatial and spectral degradation of the data, the hyperspectral analysis will be carried out on the atmospherically corrected but ungeoreferenced data. The georeferenced composites will thus be used to locate ground truth sites in the ungeoreferenced swath data.

Clark Labs will experiment with hyperspectral classification of ash species with varying levels of infestation versus context species and understory types. A variety of classification algorithms including Hyperspectral Angle Mapping, Linear Spectral Unmixing, Orthogonal Subspace Projection and band selection techniques will be evaluated.

The USDA Animal and Plant Health Inspection Service is responsible for the protection of animal and plant resources within the United States. The Pest Survey, Detection and Exclusion Laboratory, which is located on Cape Cod in Massachusetts, is one of 12 principal laboratories within the Center for Plant Health Science and Technology division of APHIS. Their aim is to provide technology, information and support for the pest survey & management programs.