

Geobotanical hyperspectral Remote Sensing
State of the Art
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6/27/01 3:02 PM

An overview of the newly emerging field of hyperspectral geobotanical remote sensing and the collaborative team at LLNL and University of California Santa Cruz developing these techniques can be viewed at <http://emerald.ucsc.edu/~hyperwww/>

Examples of our new state of the art results that include the discovery of hidden faults at Mammoth Mountain can be viewed at <http://emerald.ucsc.edu/~hyperwww/mammoth.html>

The new techniques our team is developing have shown that the previously widely accepted need for intensive fieldwork on the ground is eliminated. These “State of the Art” airborne imaging techniques can survey large areas quickly and at a reasonable cost.

HYPERSPECTRAL IMAGING METHODS

The hyperspectral geobotanical remote sensing techniques that we are developing use advanced commercial airborne imaging spectrometer systems available in the USA and worldwide. The system that we normally contract for in overhead imaging missions produces visible and near IR reflected light images with spatial resolution of 1 to 5 meters in 128 wavelength bands. Please see <http://www.hyvista.com/> The average spatial resolution of about 3 meters allows us to detect and discriminate individual species of plants as well as the complexities of the geological and man made objects in the images. We then can interpret the observed plant species distributions and their relative health along with a detailed understanding of the local geology, and the local human activities. We are able to distinguish terrestrial and aquatic plant species, all types of geological formations and soil types, and many different types of human activities. We can then look for biological impacts of seepages in large complicated areas. These techniques do not require before and after imagery because they use the spatial patterns of plant species and health variations present in the one image to detect and discriminate surface signatures.

The spatial resolution allows us to detect and to discriminate the geobotanical effects of leaks of fluids or gasses from pipelines. We are able to work equally well in terrestrial and aquatic environments. We can study environmental impacts of accidents and leaks or seepages in large complicated areas such as estuaries, ports, rivers, deserts, forests, grasslands, farmlands, cities, industrial areas, etc. In addition to routine maintenance tasks, accident evaluation and cleanup monitoring is possible for pipeline systems. These techniques should allow us to distinguish the effects of small leaks or spills from the damage caused to the environment by the other local human activities such as pipeline construction and natural factors such as storm run off or encroaching housing developments. This can be important in finding leaks that would other wise be hard or impossible to detect by direct observation.

We will be able to demonstrate the hyperspectral remote sensing methods as effective in detecting and discriminating damage to pipeline infrastructure that results from

accidents, natural disasters and from normal deterioration and operation. We will be able to show the technique is able to access the environmental impacts of disasters, accidents, and normal operation of pipelines.

Additionally we expect that commercial hyperspectral satellites will be operational in the next year or so. Please refer to the imaging sensor table at <http://emerald.ucsc.edu/~hyperwww/instruments.html> which is on the geobotanical remote sensing web site <http://emerald.ucsc.edu/~hyperwww/chevron.html> that we maintain in collaboration with Chevron Corp. In particular, the hyperspectral satellite Warfighter <http://www.orbital.com/Template.php3?Section=News&NavMenuID=32&template=PressReleaseDisplay.php3&PressReleaseID=93> on the Orbital Sciences platform <http://www.orbimage.com/> will be available for real time imaging. We also expect to see more and improved airborne hyperspectral imaging services available for hire. This should allow for continued hyperspectral imaging over many areas in the US.

The visible and near infrared (VISNIR) hyperspectral techniques are relatively well established by our work. We would like to extend our technique to include radar and the two thermal wavelength regions of hyperspectral imagery (MWIR 3 to 5 micron, and LWIR 8 to 12 micron). This could be easily accomplished by including acquisitions with SAR radar and the SEBASS hyperspectral thermal infrared instrument. Please see <http://www.lpi.usra.edu/science/kirkland/Mesa/text.html> and <http://www.aero.org/technology/index.html> for information about SEBASS. The costs for this type of acquisition would be approximately the same as for the Visible and near IR (VISNIR) hyperspectral. The Hyperspectral Applications division at Aerospace Corp. in El Segundo would do the SEBASS acquisitions.

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