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Application Notes

Keywords

- Remote sensing
- Unmanned aerial vehicle

Techniques

- Reflection
- Irradiance

Applications

- Hyperspectral analysis
- Crop assessment

Compact Spectrometers for Remote Sensing of Grassland

Written by Ocean Optics Staff

High-performance, super-lightweight Ocean Optics spectrometers are helping researchers investigate plant parameters in New Zealand grasslands and other locations. The spectrometers, one deployed as a ground unit and the other aboard an unmanned aerial vehicle (UAV), are making synchronized hyperspectral measurements of barley and sugar beet crops to assess plant characteristics and encourage more effective crop management.

Background

UAVs and spectroscopy can combine for many different remote measurements. Among the potential applications are characterization of plant and soil properties like the Normalized Difference Vegetation Index, which quantifies the amount of green vegetation in a particular environment; and imaging measurements for determination of the Leaf Area Index, which characterizes plant canopies and measures biomass, chlorophyll concentration and vegetation cover. Understanding plant characteristics leads to better crop management and erosion control.

Experimental Conditions

A multinational team of researchers led by Andreas Burkart of the Research Center Jülich IBG-2 Plant Sciences, Germany, developed the UAV-based system (Figure 1) and conducted the initial experiments, gathering high-resolution reflectance spectra from 338-824 nm at altitudes of up to 200 meters and measuring irradiance spectra from the ground-based spectrometer.

Collection of hyperspectral reflectance data by field spectroscopy is a time-consuming task and often is restricted to areas easily accessible from the ground. The UAV-based system – an STS model microspectrometer that is less than 2 inches square (40 mm x 42 mm) and weighs

a little over 2 ounces (68 g) -- overcomes those limitations, accelerating measurement sessions by up to 20x compared with ground-based spectroscopy.

Figure 1: Air-based spectral measurements can be performed very effectively across vast areas and at altitudes up to 200 meters.

Using the open-source Arduino microcontroller and with custom engineering assistance from Ocean Optics, the researchers were able to synchronize wirelessly the air- and ground-based spectrometers and both save spectral data and transmit the data to the team on the ground.

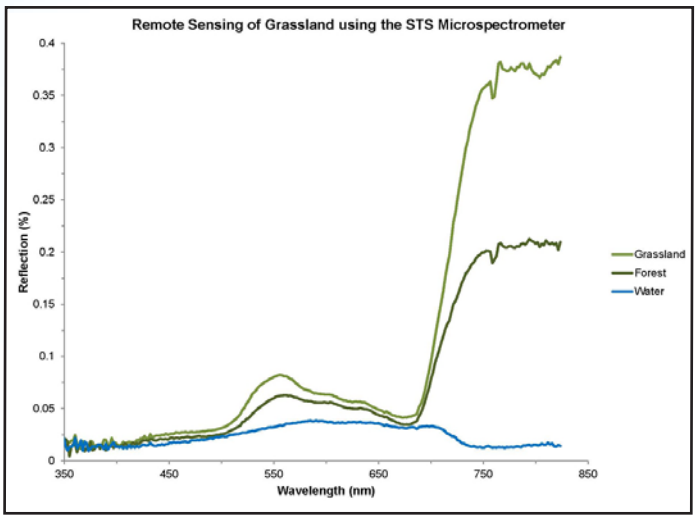

Figure 2: Reflectance characteristics of grassland reveal insight on crop health, soil erosion and environmental effects.

Conclusions

The UAV spectrometer measured reflectance of grassland, forest canopy and water with reliable results, primarily at an altitude of 10 meters (Figure 2). In fact, there was much less variation in the results with the airborne STS microspectrometer than compared with the ground-based system. Optical resolution ranged from 2.4-3.0 nm (FWHM).

The small size and weight of the STS spectrometer make it ideal for use on the UAV, allowing a series of fast and reproducible measurements over any terrain, even forest or marsh. By measuring various segments across sections of grassland and other large areas, the system is able to assess information such as specific plots that contain live vegetation and other plant life.

Sources

Burkart, A., Institute of Biology & Geoscience, Forschungszentrum Jülich GmbH, Jülich, Germany; Cogliati, S.; Schickling, A.; Rascher, U. A Novel UAV-Based Ultra-Light Weight Spectrometer for Field Spectroscopy, Sensors Journal, IEEE (Volume: 14, Issue: 1), Jan. 2014

See the UAV-based spectrometer in action at http://www.youtube.com/watch?feature=player_embedded&v=AWexcXvrkBg.

Contact us today for more information on setting up your spectroscopy system from Ocean Optics.

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