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.

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.

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.

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.

Conclusions


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

Sources


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