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Determining the directional response and field of view of two field spectroradiometers

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Abstract

Accurately determining the field of view (FOV) has rarely been considered in detail in field spectroscopy where spectroradiometer manufacturers' specifications generally lack clarity or detail. For users, the area of the scene within a FOV is largely an exercise in guess work. This issue can be further compounded with full range systems (0.4 to 2.5µm) which include multiple spectrometers each with their own field of view. In these complex systems the size and alignment of the viewing optics may cause significant spectral non-uniformity across the theoretical measurement area. When recording reflectance spectra from heterogeneous areas such as dwarf shrub (heather) canopies or agricultural crops it is important to have the scene from which the reflectance is being recorded clearly defined. If the actual FOV and its uniformity are unknown, the size of the scene and hence the support cannot be accurately calculated. In order to assess the FOV of field spectroradiometers we choose to adapt the guidelines set out in the CIE Technical Report for assessing the directional response function of photometers. A detailed set of measurements were taken of the Analytical Spectral Devices' Field Spec Pro FR and Spectra Vista Corporation's GER 3700 spectroradiometers. The resulting *directional response functions* were plotted, highlighting a number of areas of concerns.

The FOVs measured were found not to be circular for either system. The GER3700 had a wavelength dependent left/right bias in the 400nm to 1000nm range and an elongated or rectangular FOV for both the infrared spectrometers. The ASD's FOV showed spatial separation by it's individual spectrometers causing highly irregular and sparse coverage of the scene. In addition the measured FOV did not closely match the manufacturer's specified angular FOV.

The use of diagnostic absorption and reflectance features and spectral indices to determine biophysical and biochemical variables of heterogeneous vegetation canopies is dependent on reflectance being recorded from a representative sample of the scene of interest. With a heterogeneous surface, if the responsivity is uneven across the measurement field, if coverage is incomplete and if the shape and area of the measurement field are different from that assumed, then the components considered to be within the scene may not be represented in the *gross reflectance* recorded. The contribution of individual scene components to gross reflectance may be excluded or over emphasised leading to erroneous characterisation of the surface and inaccurate quantification on biophysical and biochemical variables derived from indices. Field campaigns on such targets should include within their methodologies procedures to verify the performance and repeatability of the optical equipment used.