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Mapping Vegetation Types with the Multiple Spectral Feature Mapping Algorithm in Both Emission and Absorption

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Vegetation covers a large portion of the Earth's land surface. Remotely sensing quantitative information from vegetation has proven difficult because in a broad sense, all vegetation is similar from a chemical viewpoint, and most healthy plants are green. Plant species are generally characterized by the leaf and flower or fruit morphology, not by remote sensing spectral signatures. But to the human eye, many plants show varying shades of green, so there is direct evidence for spectral differences between plant types. Quantifying these changes in a predictable manner has not been easy. We have applied the Clark *et al.*, (1990, 1991) spectral features mapping algorithm to mapping spectral features in vegetation species.

The human eye sees different plant leaves as shades of green, as characterized by the "green peak" in reflectance spectra (Figure 1). The eye/brain color system is able to differentiate shades of green under different lighting conditions. For example under indoor incandescent light there is a strong red slope to the spectral signal received by the eye due to the red spectral shape of the light source (as compared to the same plant in direct sunlight), but we are still able to distinguish the plant as green and distinguish different plants as various shades of green.

The spectral feature mapping algorithm referenced above has been extended to map simultaneously both absorption and emission features. Strictly speaking, in reflectance spectra of rocks, soils, and vegetation in the 0.4 to 2.5 μm region, there are no emission features. However, there are "relative reflectance maxima," hereafter called "emission" features. Thus the reflectance spectrum of any material can be thought of as a combination of absorption and "emission" features.

We consider the green peak in vegetation spectra to be an "emission" feature (Figure 1). A continuum is drawn at the minimum on each side of the peak, and the continuum removed by division. Removal of a continuum reduces the effects of background materials in the pixel analyzed. To further characterize the vegetation, additional features in the vegetation spectrum are analyzed (e.g. Figure 1, features B, C and D). We have found that the spectral feature mapping algorithm is very sensitive to the shape of the features and has the potential to distinguish more subtle differences in the visible spectrum of plants than can the human eye. An example of the variation in the shape of the "green peak" is illustrated in Figure 2. With the additional information in the near infrared, the algorithm can be used to differentiate the subtle spectral differences between them.

We have applied this method, along with reference spectra of plants, to map vegetation in AVIRIS scenes.

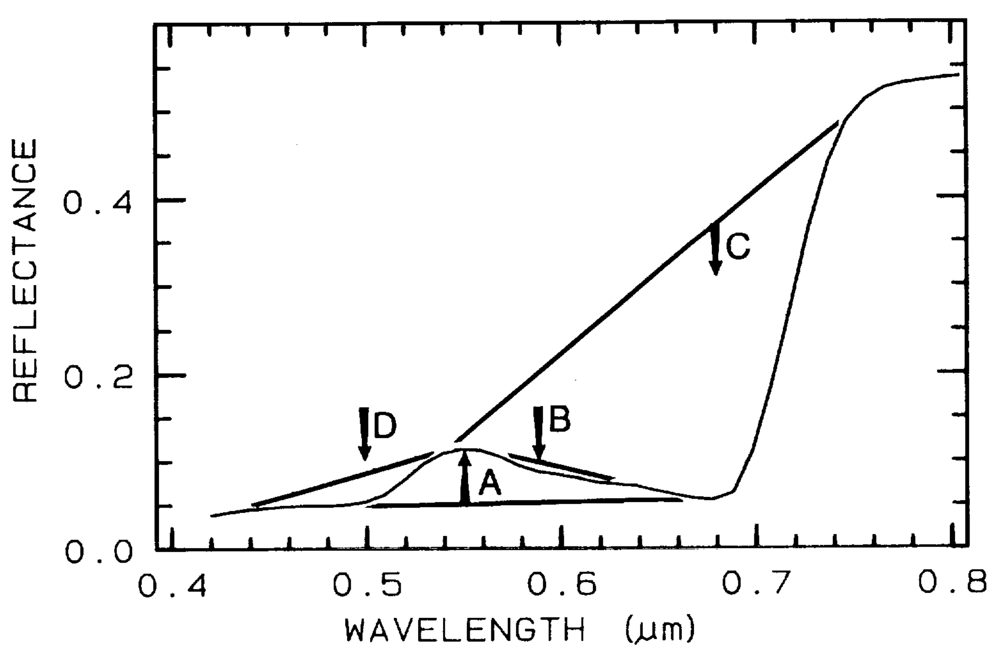

Figure 1. Example spectrum of green vegetation. Sample continua used to define "emission" (A) and absorption (B, C, and D) features.

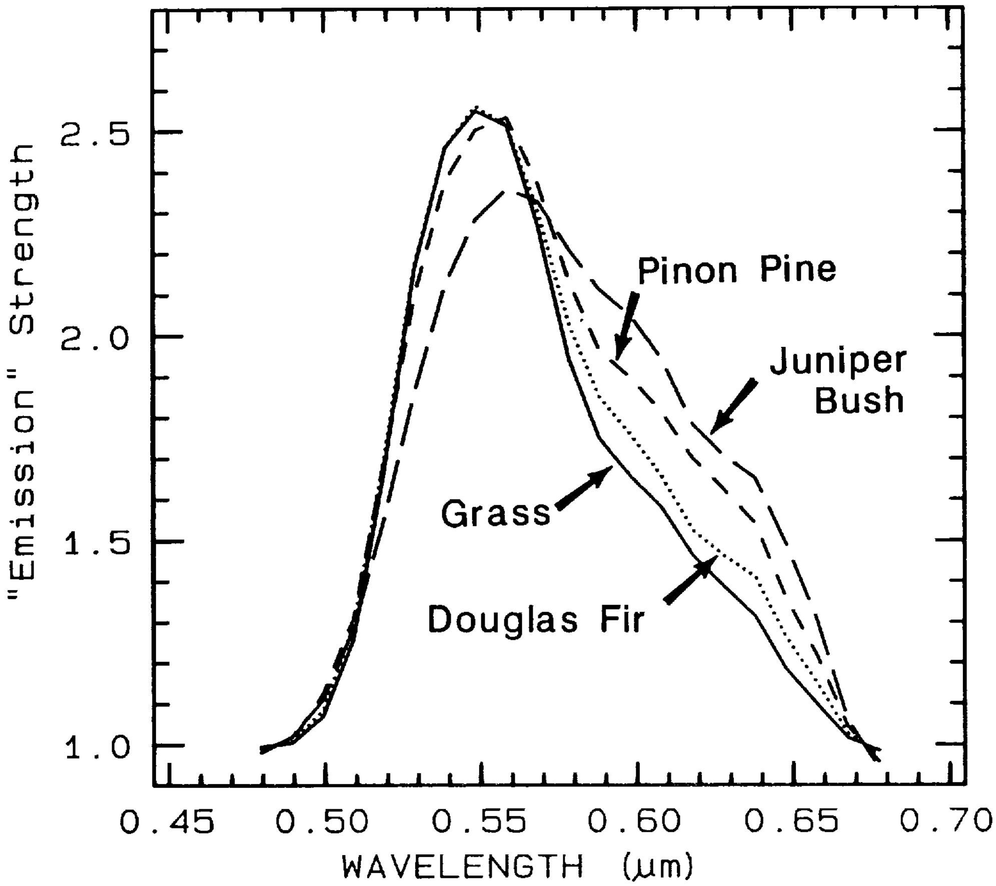

Figure 2. The normalized "emission" strengths of the green peak in 4 plant species are shown. The Douglas fir, pinon pine, and juniper are all in the Pine family and grow in the same area, yet have spectral structure that may be used to distinguish between them. The spectra are at AVIRIS spectral resolution.

References

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