WITHIN- AND BETWEEN-CLASS VARIABILITY OF SPECTRALLY SIMILAR TREE SPECIES

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1. BACKGROUND AND OBJECTIVE

Spectral signatures for samples of the same species of vegetation have high variability [1] and when comparing spectrally similar species the problem is further enhanced [2]. Hence techniques that are presently used for image classification and/or spectral unmixing often cannot be directly used for vegetation studies to distinguish spectrally similar species [3]. Most researchers in the past have ignored this or have used the mean spectrum for the class for which image classification and/or spectral unmixing techniques are based on the mean spectra. This results in (i) a loss of valuable information and (ii) undistinguishable mean spectra for spectrally similar vegetation species.

The two main types of variability, which is necessary for any image classification and/or spectral unmixing technique are (i) the variability within a species class, and (ii) the similarity between the species classes [4]. When the variability within a species class is small compared to the variability between the species classes, this results in relatively good accuracy in the results for image classification and/or spectral unmixing. However, when the species spectra is similar, the within species variability can be large compared to the between species class variability and thus producing poor results for image classification and/or spectral unmixing techniques.

This research studies the variability within a species class and the variability between the species classes of seven spectrally similar tree species. The hyperspectral signatures, using an ASD spectrometer, recorded 10 samples for each of the seven species in the Kruger National Park in South Africa. This research presents ways in which the within species class variability can be reduced compared to the between species class variability.

2. METHODOLOGY

In the past several researchers have considered using the first and second derivatives of the spectra to improve the image classification and/or spectral unmixing results [5, 6, 7] without actually reflecting the within and between species variability. Here I evaluate the within class species variability and the between classes species variability for the first and second derivative spectra. I then applied a B-Spline smoothing technique to the spectra and compare the within and between class variability. Furthermore, I conduct the experiment (i) over the entire electromagnetic spectrum (0.4 μm–2.5 μm), (ii) the visible (VIS) part of the electromagnetic spectrum, (iii) the near infrared (NIR) part of the electromagnetic spectrum, and (iv) the short wave infrared (SWIR) part of the electromagnetic spectrum. I also selected certain spectral bands to reduce the high correlations between species and compared the inverse matrix, since it is already well known that an unstable inverse matrix will result in a drop in estimate accuracy for image classification and/or spectral unmixing [8, 5, 9]

3. CONCLUSIONS

From the results I then recommend, when conducting image classification and/or spectral unmixing what is the best form of the data to use, which reduces the within class species variability compared to the between classes species variability. I also give recommendations as to the part of the electromagnetic spectrum which is best suited for these tree species discrimination based on the within class species variability and the between classes species variability.

4. REFERENCES

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