Undergraduate Research Opportunities Programme

University of Reading

Spectral signatures of the solar irradiance within the tree canopy shade

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Key definitions

Spectral signatures: Radiation reflected by an object in relation with its wavelength composition.
UAVs: Unmanned Aerial Vehicles, commonly known as “drones”. They can be driven autonomously and maintain course of flight.
Spectrometry: Technique for measuring the composition of light from various regions, spanning from ultraviolet to visible and infrared wavelengths.
Wavelength: Distance between two peaks of electromagnetic spectrum. Each area is defined by a different colour (see Figure 1).

Introduction

In the present era, the mapping of vegetation and assessing the health, production, and canopy structure of plants is often carried out using various remote sensing sensors deployed on platforms like satellites, UAVs (Unmanned Aerial Vehicles), and Lidars. However, this approach can sometimes encounter an issue referred to as "Mixed Pixels Contributions." Mixed Pixels occur when the sensor captures contributions from both canopies and background surfaces, leading to biased results in remote sensing data. This problem tends to be more prevalent in areas with less dense vegetation, such as urban areas or cities, where multiple components within a pixel need to be considered, including factors like shadows

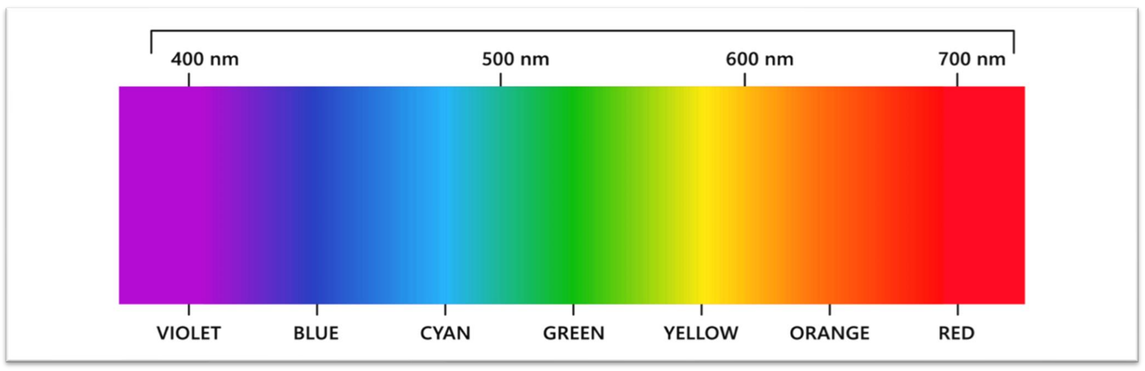

Figure 1: Wavelengths of the visible light, presented in nanometres (nm)

Why is this important?

The presence of biased results in vegetation mapping can lead to inaccurate predictions of vegetation density and health in urban areas. In such scenarios, an in-depth analysis of the spectral composition of shadows becomes crucial (spectrometry). By understanding the information contained within these shadows, we can evaluate and incorporate it into more advanced mapping models, leading to more accurate estimations. This approach ultimately contributes to enhancing the quality of life for those who benefit from tree canopies in urban areas or cities.

Method

Recording of the spectrum of light in the top of the canopy (background) and within the tree shade.

Data classified by date, sets and blocks. Each for the sets was composed by 3 readings on the top and 3 on the shadow.

The final summary of recording was analysed using Excel, creating plots of spectrum and comparing with literature.

Some ratios of light were created to be used in further steps, this ratios can contain important information about the canopy filtering capacity and health.

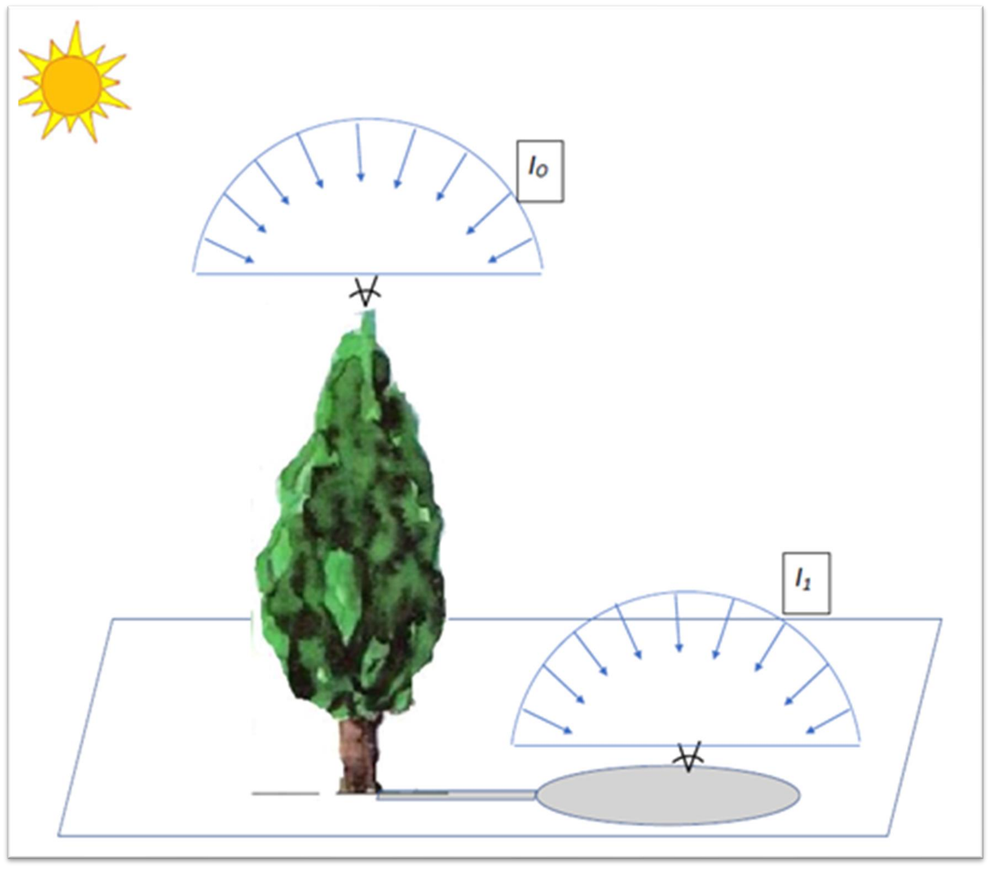

Figure 2: Diagram of the method of recordings for the canopy

Findings and further steps

- In general, the results obtained for the spectrum charts corelates with those of similar studies.
- As expected, the shape of the spectral signatures showed a decreasing trend similar to what is described in literature (see Figure 3).
- The amount of light attenuates as the hight of the recording gets closer to the ground, providing information about the filtering capacity of the leaves.
- Some results obtained suggest that the information contained within the shade can be used to estimate the area occupied by the leaves of the canopy in a non-destructive way.
- Even though this study has not been concluded yet, this is the starting point for further investigation into this topic.

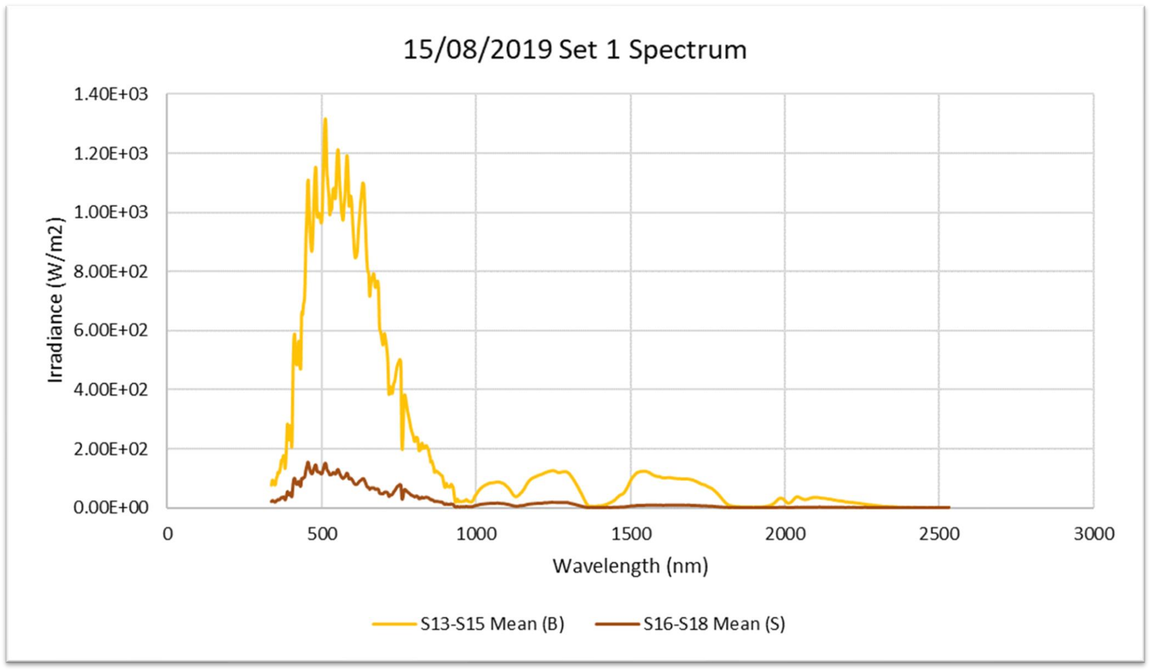

Figure 3: Spectral signature graph showing background (B) and shade values (S)

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