

TECHNICAL NOTE TN2021_5 – HEAT ON SAMPLES

Introduction

In this TN, we highlight of the samples reflectance is actually effecting the heat load on sample measurement.

VNIR = VISIBLE NEAR INFRARED (400 – 1000 NM)

NIR = NEAR INFRARED (900 – 1700 NM)

IR = INFARED (ABOVE 700 NM)

LED = LIGHT-EMITTING DIODE

Article

Several illumination sources are available for hyperspectral imaging (see TN2021_7_Illumination). Some of them may heat up the samples and careful attention is required to choose the right one.

The heat induced by the illumination is depending on two factors: 1) the spectral content of the source, and 2) the spectral reflectance (or absorbance) of the sample.

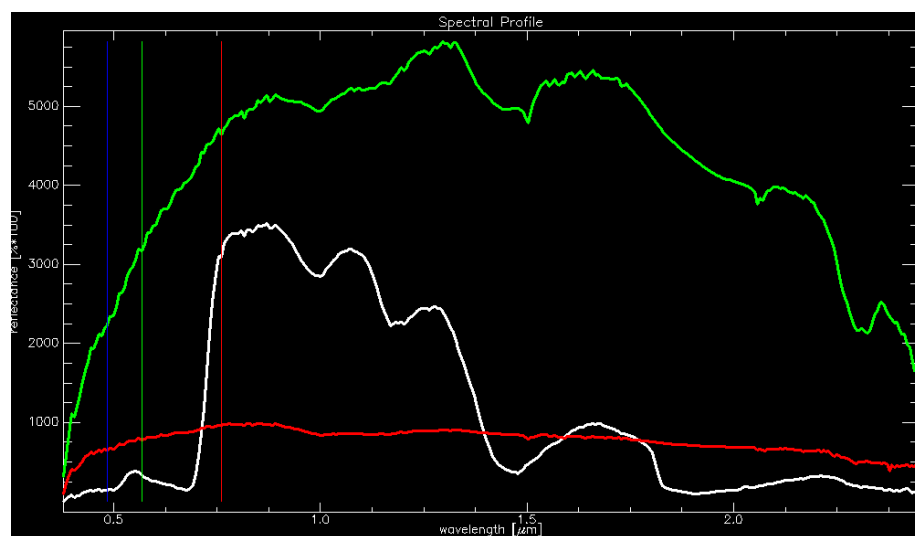


Figure 1: spectral reflectance of a tree (white), old grey asphalt (red) and sandy road (green)

In Fig.1 the typical VNIR – SWIR spectral reflectance of vegetation, grey asphalt and sandy road are represented. From this, we can deduce that:

- a sandy road is highly reflective
- an old road made of asphalt is mostly absorbing the light
- vegetation is somehow in between, having high reflection in the NIR but absorption in the visible (except in the green) and the longer IR region.

When a sample absorbs the light, the energy embedded with the absorbed radiation is converted into heat. That is why under sun light, a sandy road will not heat much, tree a bit more, and an asphalt road will become very hot (even melting in a hot summer day).

Then comes the light source. In order to limit the heat on samples, the best approach is to limit the spectral range of the illumination.

- filter: using a band pass filter would limit the illumination to the relevant spectral range. Then all wavelengths which are not needed will not cause any heating of the samples. The filter may get hot, if it absorbs the light outside of the wanted spectral range, or it may remain cold, if it reflects backwards the non desired light.
- LED or supercontinuum lasers: those are light sources whose spectral emission can be tuned accordingly. Their spectral range is usually rather limited, limiting the heat load on samples.

If limiting the spectral range is not an option, there are still several possibilities:

- cold halogens with fiber guide and line light: the spectral range is usually limited to VNIR, limiting the heat load on samples.
- some fans can be mounted next to the samples when they pass below the illumination (here the relevant on fans is highlighted in another TN, TN2021_6, related to heat on samples within the context of art works)

And finally, SPECIM hyperspectral cameras are line scan devices, which means that a movement is always needed to image samples. Either samples are placed on a conveyor or a scanner, either the camera is moving. A short exposure to the illumination is the best way to prevent heating up. Therefore, to prevent heat on samples, we recommend to move the samples, as quickly as possible.

Disclaimer

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Version history

Version	Date	Author	Comments
1.0	Feb 18 th 2022	MMA	