TECHNICAL NOTE TN2021_11 – WHAT TO TAKE INTO ACOUNT WHEN MEASURING TRANSMITTANCE?

Introduction

This TN explains what a transmission measurement is, and how a scanner for that purpose should be designed.

Article

We sometimes get inquiries regarding transmission scanners. Those would be used when the user wants to measure the transmittance of samples, with the camera on one side of the sample, and the illumination on the other side. In this technical note, we discuss potential pitfalls and what should be considered when proceeding with such measurements.

Figure 1: sketch of a transmittance system geometry.

1. Ambient light

Ambient light having access to the sample surface will cause the user to measure, instead of pure transmission, a mixture of transmission and reflection from the surface. Thus, the system either should be operated in a perfectly dark room – not easy to implement – or preferably prevent the ambient light by designing an enclosure around the system.

Typical transmission signal is rather low, and a high integration time is needed. It means that the ambient light reflection, if present, may strongly dominate what the camera actually measures. In case of transmission measurement, even the light from the computer monitor can distort the result.

2. Stray light

Following the previous paragraph, an enclosure should be used to prevent ambient light to reflect on the samples. However, designing a proper enclosure is not trivial. In fact, the illumination, going through the sample or the transmission window may bounce on the enclosure wall, and then reflect again on the sample surface, leading to excess reflection.

Also, space between samples and on their edge will cause two types of stray light related issues:

1) the direct illumination will hit the front objective of the camera, then bouncing back to the samples. This will again cause unwanted reflection.
2) the direct illumination is many times more intense than the transmitted light, causing simply stray light in the whole system, polluting the transmission signal of the samples.

To avoid any excess stray light, SPECIM would recommend to use masks on the transmission window or line having the shape of the samples, avoiding unnecessary direct light to go through the system.

3. White referencing

For a successful transmission measurement, white referencing also plays a role and special care for the normalization should be taken into consideration.

White reference is crucial in hyperspectral imaging, regardless the measurement geometry (reflectance, absorbance and transmission). It measures the incident light (before reaching the sample), seen by the camera (taking into account the QE of the detector and the transmission of the optics). For classic reflectance geometry, a diffuse white tile is typically used. However, the same tile can not be used for transmittance geometry, as it is rather opaque. A thinner tile could be used, letting some light passing through, without blinding the camera.

Another approach would consist in using white or grey Opal glass. This material could be used as support to convey the samples, and measuring the light passing through would be appropriate. Besides, Opal glass would act as a diffuser, improving the measurements homogeneity.

But in any case, we do not recommend to measure directly the incoming light. Direct light would be measured with a very low integration time, whereas samples would require a much longer one. This mismatch of integration time could be corrected with a dual integration time approach.

A proper transmission system requires very careful planning and designing. Moreover, its use needs to be well documented.

Disclaimer

Version history

Version	Date	Author	Comments
1.0	Feb 18th 2022	MMA	