From spectral imaging to reflectance image

Antony MADALENO

usefull site : brucelindbloom.com

Context and Objectives

In this lab, students will proceed to manipulate multispectral image.

The objectives are:

- **Acquire** a hyperspectral image.
- **Spectral to Reflectance** : compute the reflectance cube based on the characteriazed illuminant used to capture raw spectral cube.

Key Definitions

- **Tristimulus** : Three functions representing RGB responses of a sensor, for exemple the human eye.
- **Standard Illuminant** : A standard illuminant is a theoretical light source with a known spectral power distribution (SPD), used as a reference in color measurement. Common examples include:
  - D65 : Represents average daylight (≈ 6500 K).
  - D50 : Warmer daylight (≈ 5000 K).
  - A : Incandescent tungsten light (≈ 2856 K).

  The choice of illuminant affects how a color is perceived and therefore plays a crucial role in accurate color reproduction.

1. Acquire hyperspectral image

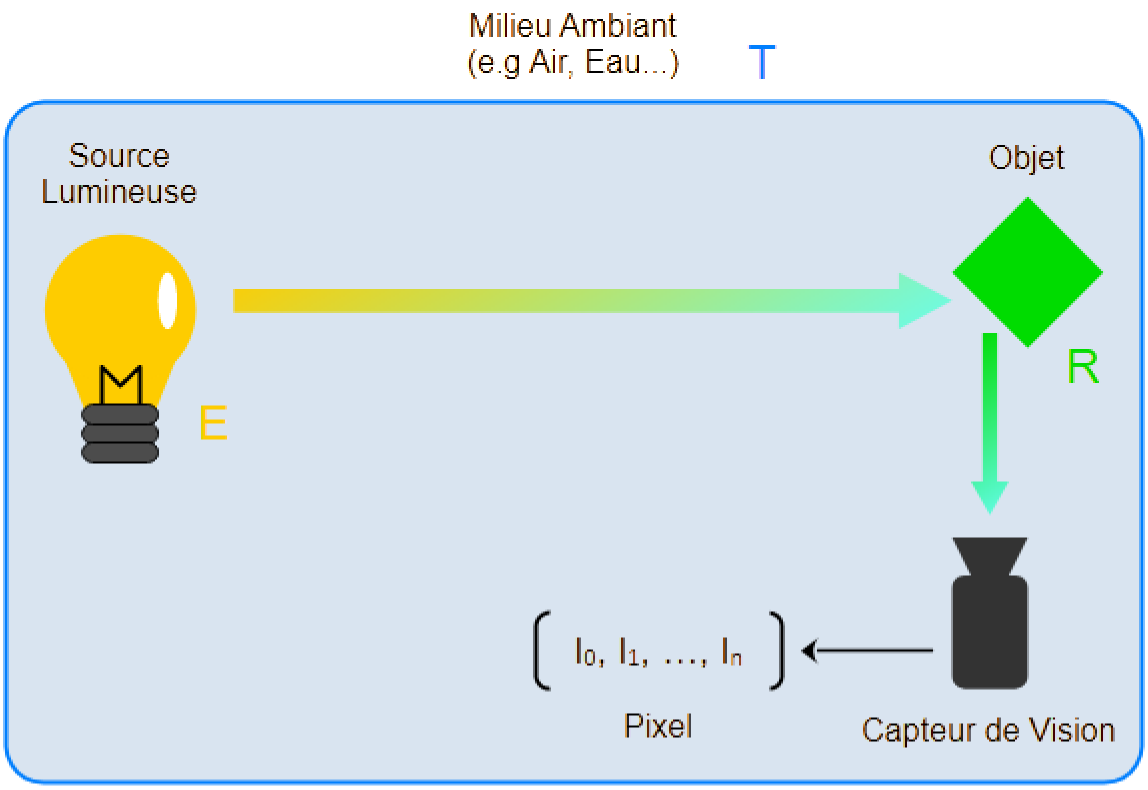
- setup the scene (surface, lighting and camera).
- acquire hyperstral image.

Note : The lighting parameters used will be the same as the one used in previous lab.

2. Spectral to Reflectance conversion

Input Data :
You will work with a spectral cube your acquired. The cube consists of spectral signatures over a range of wavelengths for each pixel.

Available Illuminants :
Several standard illuminants will be provided, including D65, D50, and A. You will be asked to perform the transformation for at least one of these illuminants and compare your results.



Equations :

$$R = \frac{M}{(I \times S)}$$

I : illuminant spectral power distribution
R : reflectance spectra
SSF : spectral sensitivity of the sensor

Tasks :

- Compute the CIE XYZ tristimulus values for each pixel in the reflectance cube.
- Use the appropriate color matching functions and the selected standard illuminant.
- Visualize the resulting XYZ image or slices (e.g., mapping X, Y, Z channels to RGB for visualization purposes).
- Compare and discuss the effect of different illuminants on the resulting XYZ values.