

NTNU

TTK4255

# Robotvision

Hyperspectral imaging

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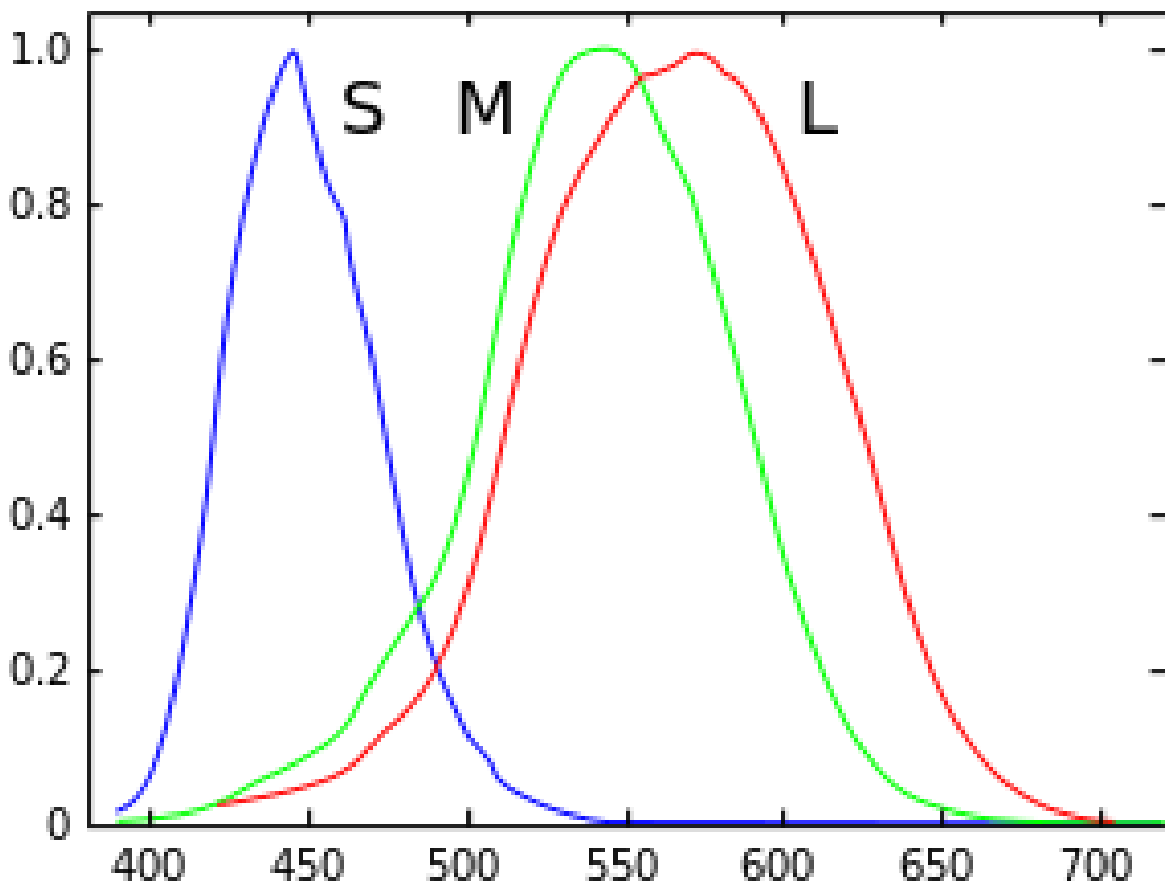


Figure 1: Graph for the human color sensitivity curves, according to Wikipedia [1]

## 1 Getting familiar with the data

### 1.1 Finding the spectral resolution

To find the spectral resolution of the dataset, we load the *hico.wl* array, which contains the wavelength corresponding to band  $i$ . We loop through the array and compare each wavelength  $i$  with the previous wavelength  $i-1$  and we find that the average distance between the wavelengths is  $5.728nm$ , which seems to be constant between all wavelengths.

### 1.2 Relation to human color perception

The color sensitivity of the human eye is shown in fig. 1. As we can see, blue color has a peak around  $445nm$  (*S*-curve), green peaks at  $535nm$  (*M*-curve), and red at  $575nm$  (*L*-curve).

### 1.3 Create a pseudo RGB image from the hyperspectral bands

From the *hico.wl* array, we find that Blue ( $445nm$ ) is located at index  $i = 7$ , green ( $535nm$ ) at  $i = 23$ , and finally red ( $575nm$ ) at  $i = 30$ . We combine these indices from the HICO dataset and show it as an image to create a pseudo RGB image, shown in fig. 2.

Fix image

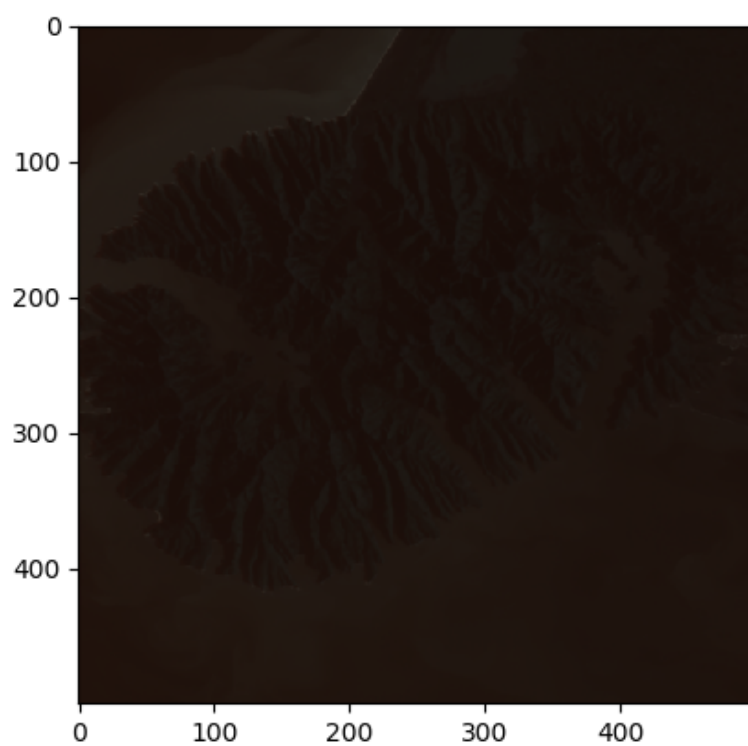


Figure 2: Pseudo RGB image

1.4 Representative spectra for selected points

## 2 Classification & Bio-geophysical Parameter Retrieval

2.1 Can we predict where there is chlorophyll through classification?

2.2 How well can we directly estimate the chlorophyll content?

2.3 How can we estimate the reflectance from the surface of the ocean?

2.4 Compute chlorophyll concentration using atmosphere-corrected data

2.5 Classify land versus water

2.6 Other bio-geophysical parameters

2.7 Alternative atmospheric correction methods

## 3 Dimensionality Reduction & Noise Filtering

3.1 What is dimensionality reduction?

3.2 Principal Component Analysis (PCA)

3.3 How does dimensionality reduction via PCA affect classification?

3.4 Maximum Noise Fraction

3.5 Maximum Noise Fraction on HICO noisy

3.6 Discuss your results

3.7 How can we best use the subspace?

## 4 Fun but definitely hard problems

4.1 Deep learning

4.2 Multispectral-hyperspectral image fusion

4.3 Spatial-spectral methods

4.4 Locating methane emissions

## References

- [1] Wikipedia. *Spectral sensitivity*. Jan. 2020. URL: [https://en.wikipedia.org/wiki/Spectral\\_sensitivity](https://en.wikipedia.org/wiki/Spectral_sensitivity).