Structure and Composition of Remote Sensing Images

Introduction to Sentinel-2 Imagery

What is Sentinel-2?

- Sentinel-2 is a satellite mission developed by the European Space Agency (ESA) as part of the Copernicus program[1].
- The mission comprises a constellation of two satellites, Sentinel-2A and Sentinel-2B, which provide high-resolution optical imagery.

Applications:

- Monitoring of vegetation, soil, and water cover.
- Disaster management, including assessment of hurricane damage.
- Land cover classification and agricultural monitoring.

Understanding Sentinel-2 Imagery

Image Composition:

- Sentinel-2 captures images in multiple spectral bands.
- Each band corresponds to a specific wavelength range of light, capturing different information.

Spectral Bands:

- Sentinel-2 images are captured in 12 spectral bands ranging from visible to shortwave infrared.
- Commonly used bands include:
    - **Blue (Band 2):** 490 nm
    - **Green (Band 3):** 560 nm
    - **Red (Band 4):** 665 nm
    - **Near-Infrared (NIR, Band 8):** 842 nm

RGB Image Composition

What is an RGB Image?

- An RGB image is composed of three color channels: Red, Green, and Blue.
- Each channel captures the intensity of light in the respective wavelength range.

RGB in Sentinel-2:

- Sentinel-2 bands corresponding to RGB:
  - **Red:** Band 4
  - **Green:** Band 3
  - **Blue:** Band 2
- These bands can be combined to create a true-color image.

Image Data Structure

Pixel and Resolution:

- An image is a grid of pixels, each representing the intensity of light at a specific point[2].
- Resolution refers to the size of each pixel. Higher resolution means finer detail.

Image Channels:

- Each channel in an RGB image is a 2D array of pixel values.
- Combining the channels forms a 3D array (height x width x channels).

Image Data Structure

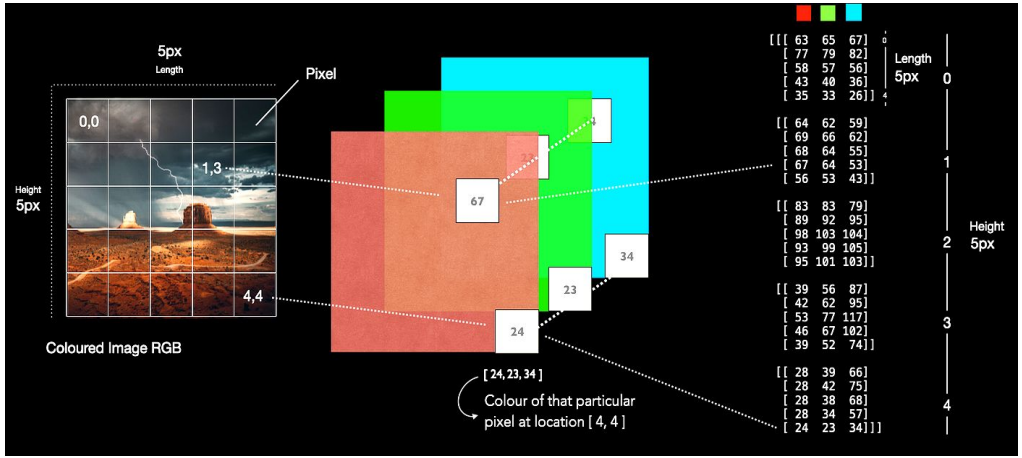

Fig 1: Representation of RGB Reference

What is a TIFF File?

TIFF (Tagged Image File Format):

- A flexible and adaptable file format for handling images and data within a single file
- Can store multiple images or multi-channel data in a single file
- Supports a variety of color spaces and compression schemes

Usage in Storing Data:

- Commonly used in remote sensing and geospatial data storage
- Ideal for high-resolution images and large datasets
- Retains metadata and geographic information

Introduction to NDVI

NDVI (Normalized Difference Vegetation Index):

- Measures vegetation health
- Calculated using near-infrared (NIR) and red light (Red) bands

Formula: NDVI = (NIR - Red) / (NIR + Red)
Example: Figure shown.

Importance:

- Indicates presence and condition of vegetation
- Used for monitoring crop health, forest cover, and ecological changes

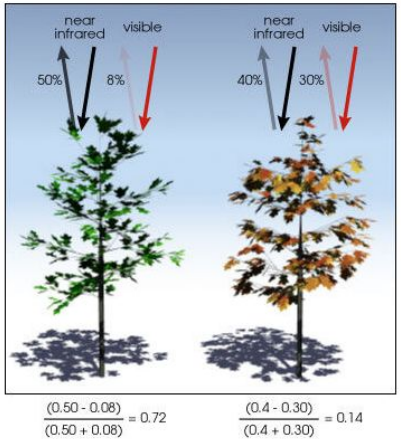

Image courtesy of NASA.

Future Work

Use classical ML methods as examples of the simplests NNs

- Training NN
- Evaluate NN

References

[1] *Sentinel 2 Satellite Images*. (n.d.). 2024 EOS Data Analytics,Inc. https://eos.com/find-satellite/sentinel-2/.
[2] Lehn, F. V. (2024, June 1). Understanding the Structure of RGB Images and How Pixel Values Represent Color. *Medium*.https://medium.com/advanced-deep-learning/decoding-image-representation-understanding-the-structure-of-rgb-images-6a211eb8800d
[3]