Project Title

Spectral classification of Chandrayaan-2 IIRS using AI/ML for understanding geological diversity of the Moon

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Introduction

Project Overview

The IIRS is the highest spectral and spatial resolution hyperspectral dataset of the Moon, available from Chandrayaan-2 mission. The data has immense use in understanding the Moon's geology. The data will be classified after categorising them based on similar spacecraft geometry to minimize the geometry-based effects. A well-covered region on the Moon will be selected for further analysis. The AI/ML tools will be used for quick spectral classification that can be further linked to mineral characterisation.

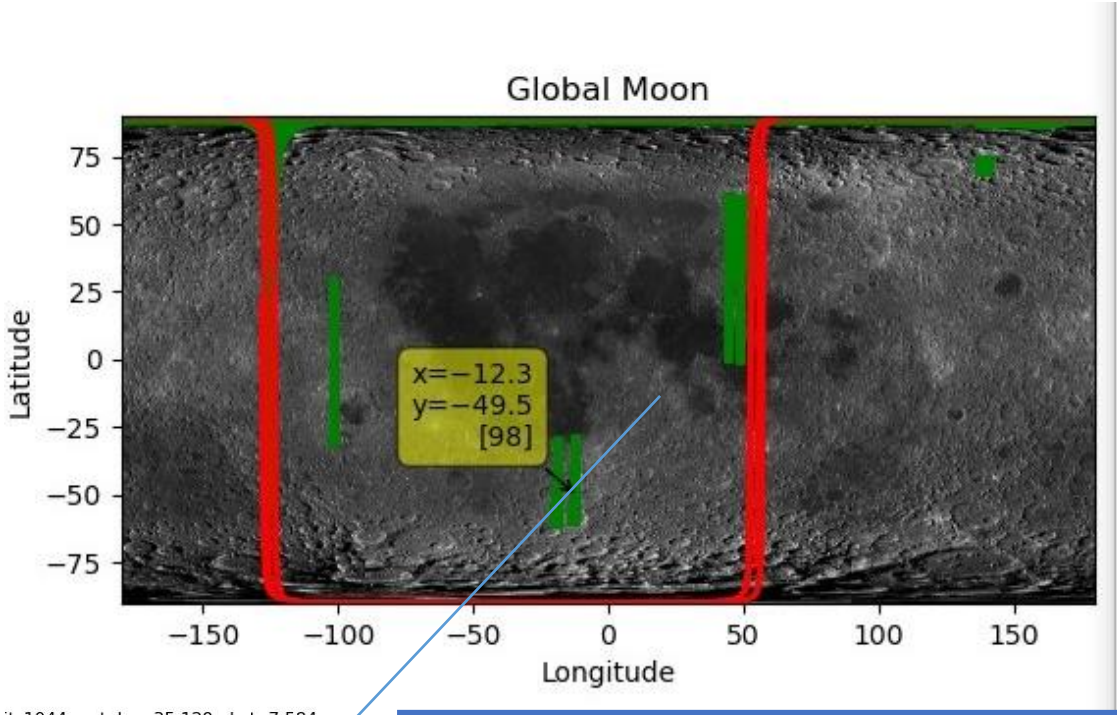
Understand the terminology:

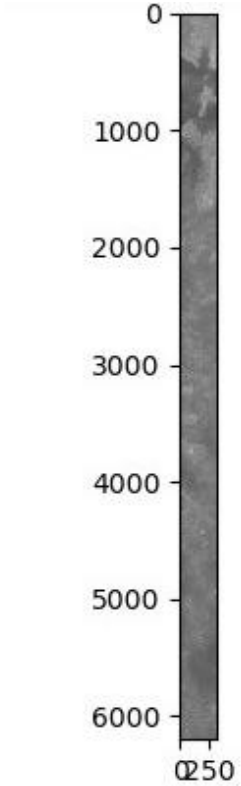
- Understanding the hyperspectral data-set : Go through IIRS user guide and sis pdfs that can be downloaded from: https://pradan.issdc.gov.in/ch2/protected/miscDownloads.xhtml
- Download the data of a specific period: Go to https://chmapbrowse.issdc.gov.in/MapBrowse/ and search data. Example: for longitude range -94 to -90 and latitude range -20 to -24.
- Open data: read xml header first and then as per band, line and sample information, use appropriate function from Python/Matlab.
- Wavelength corresponding to each band is given in xml (header) file.
- *This project demands high-end computation due to huge data volume and processing required*

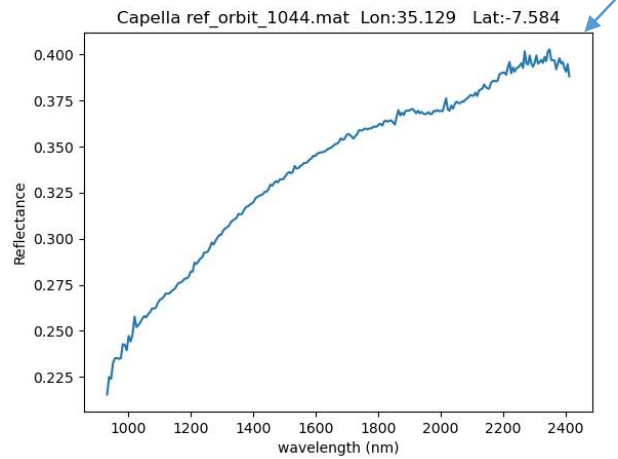
Plan of Work

Data Visualization:

Example:







Expectation:

- Put global Moon in background, as per latitude and longitude information, put IIRS strip, display IIRS one channel as image and extract a spectrum from the cursor position.

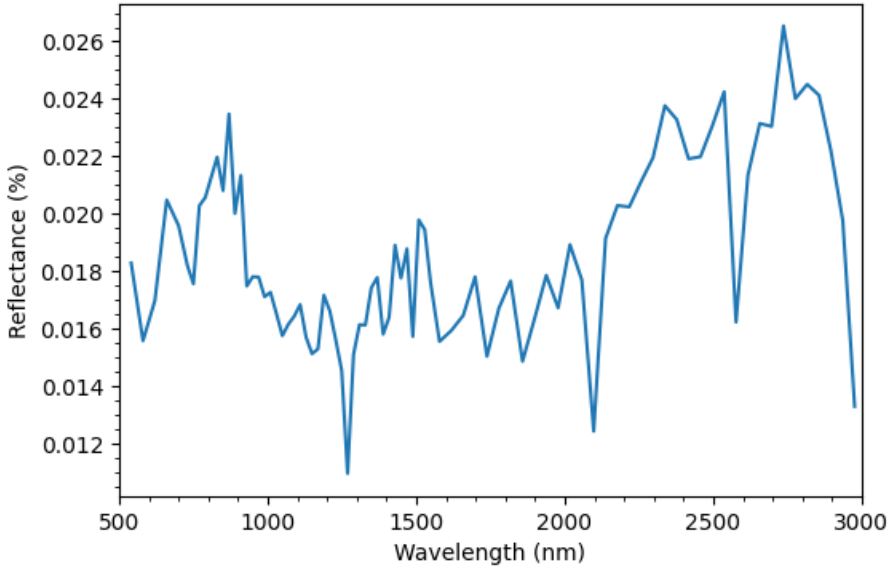
Reference: 2021 M.Sc thesis, PRL and Gujarat University

Plan of Work

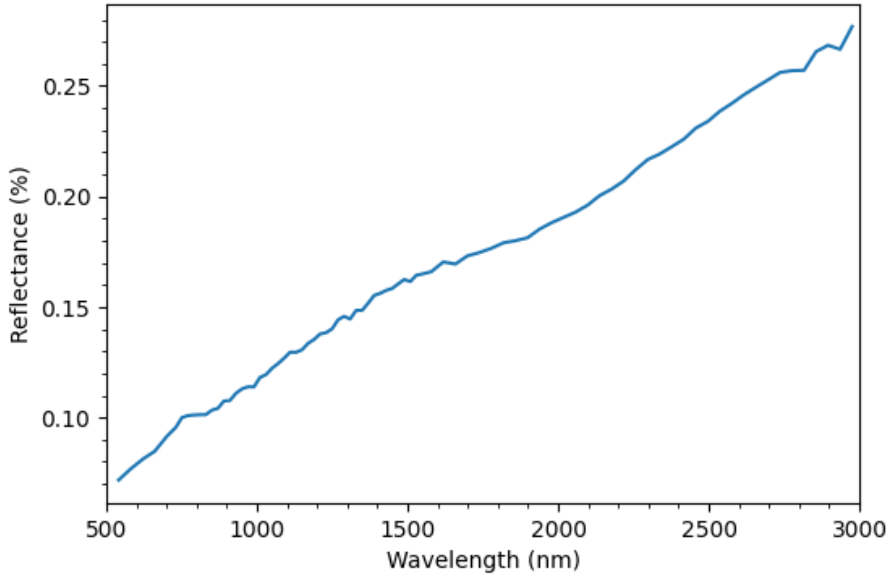
Select data and apply AI/ML for grouping spectral classes:

Example:

1. Select IIRS data from Orientale basin region based on similar observation characteristics like exposure and gain settings, observation (phase) angle. This information can be extracted from the header files.
2. Covert radiance to reflectance using Equation given in SIS document of IIRS.
3. Clip data to 200 bands.
4. Remove noisy spectra that if present will be problematic for model development.



Noisy spectrum to be removed



Reflectance spectrum to be kept

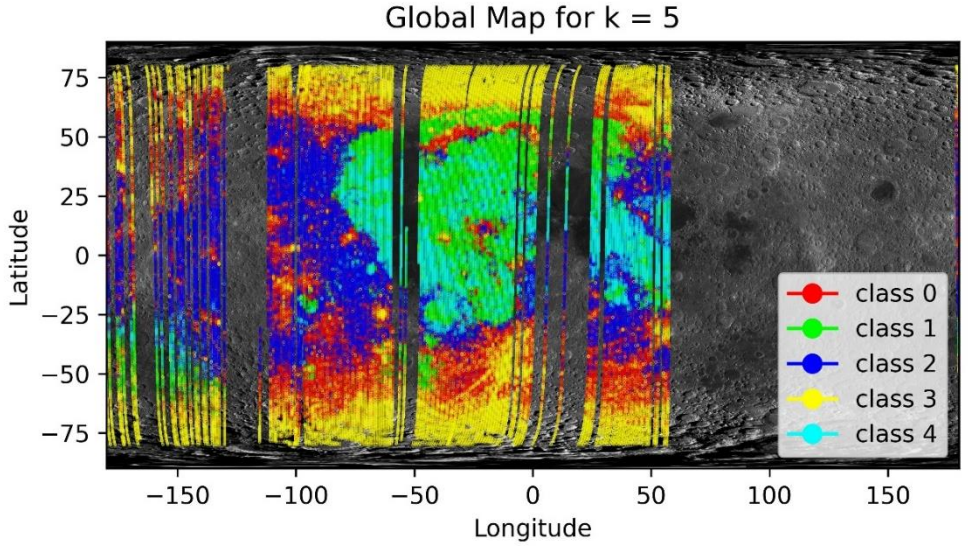
Example is shown using M3 data (Chandrayaan-1)

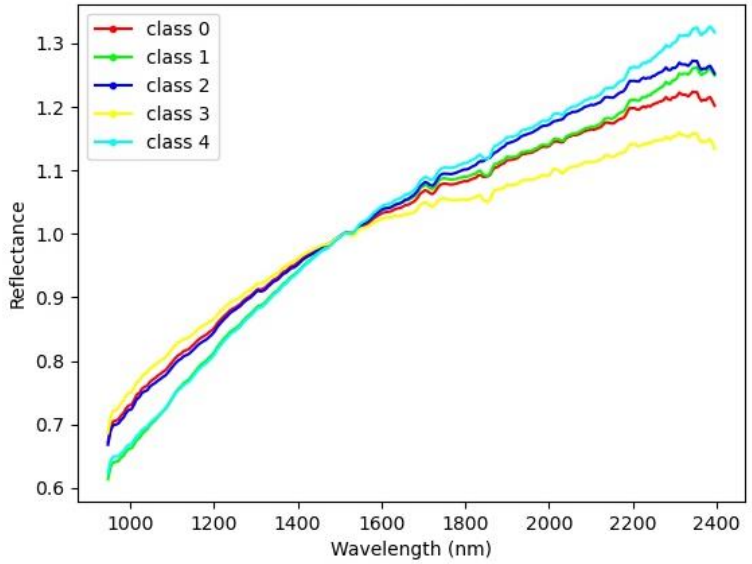
Plan of Work

Select data and apply AI/ML for grouping spectral classes:

Example:

1. Apply unsupervised learning algorithms like isolation forest, Gaussian mixture model etc for selecting and removing noisy spectra.
2. Use ML/AI approach to extract spectral clusters. Use normalized spectra for clustering. It means divide the spectrum with its band number corresponding to 1.5 µm wavelength.





Example is shown using SIR-2 data (Chandrayaan-1, 2021 M.Sc thesis, PRL and Gujarat University)