Hyper Spectral Image Unmixing

A Mini Project Progress Report
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in
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by

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1 Introduction

Hyperspectral images provide much more information than conventional imaging techniques, allowing a precise identification of the disparate materials in the observed scene. Extraction of detailed information about the material properties of pixels in a scene caters for both civilian and military applications. But because of the limited spatial resolution, image comprises mixed pixels. Mixed pixels are a mixture of more than one distinct substance. The spectral unmixing problem aims at recovering the spectra of the pure materials of the scene called endmembers, along with their proportions called abundances in each pixel [2].

2 Dataset

A lot of hyper spectral image dataset available for the unmixing procedures. Most of the datasets are available in both .mat and .envi format. Few of the many is listed below,

- Samson
- Cuprite
- Jasper Ridge

2.1 Samson

Samson is a dataset which contains image of shape 95x95 over 156 channels. There are 952x952 pixels in total. 156 channels covering the wavelengths from 401 nm to 889 nm. It has three endmembers as follows:

- Soil
- Tree
- Water

Reading the Samson dataset in .mat format and representing image of each band is as shown in Figure 1.

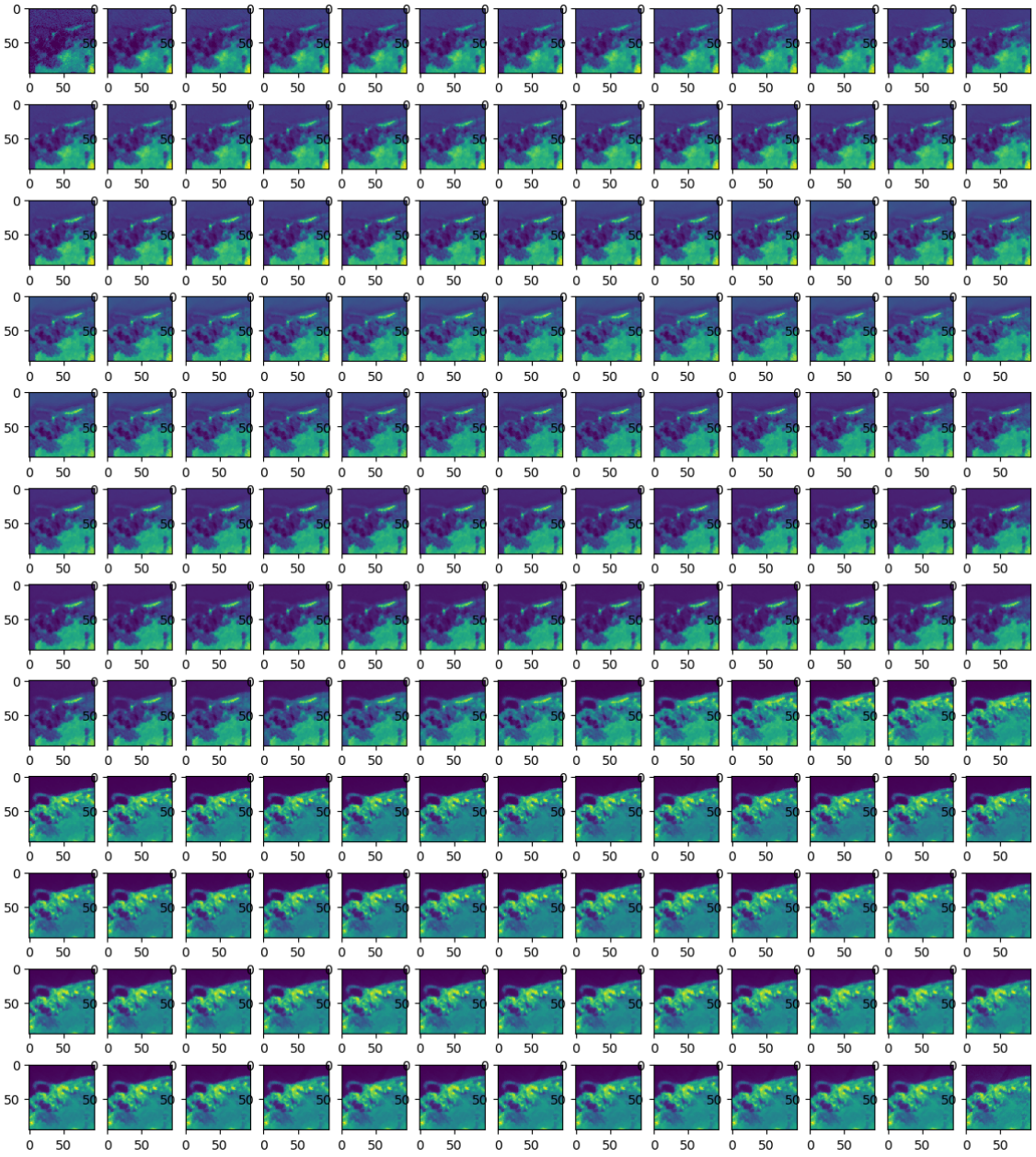

Figure 1: Images of all 156 bands in Samson Dataset

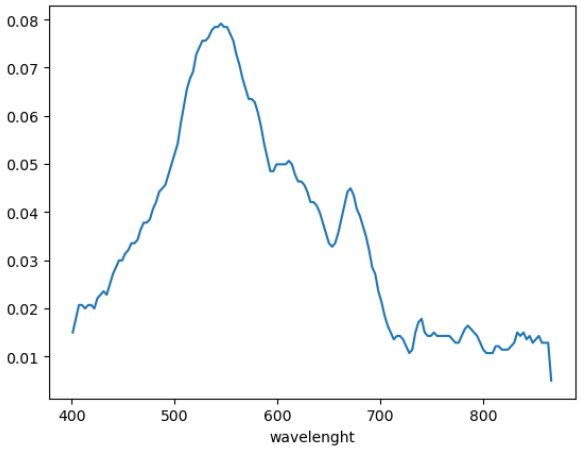

Figure 2: Spectra of the first pixel in dataset

2.2 Cuprite

Cuprite is the most benchmark dataset for the hyper spectral unmixing research that covers the Cuprite in Las Vegas, NV, U.S. There are 224 channels, ranging from 370 nm to 2480 nm. Of the 224 bands only 188 channels remain after removing the noisy channels and water absorption channels. A region of 250x190 pixels is considered, where there are 14 types of minerals. But the number of endmembers reduces to 12 due to few indistinguishable minerals.

The distinct endmembers are as follows:

- Alunite
- Andradite
- Buddingtonite
- Dumortierite
- Kaolinite1
- Kaolinite2
- Muscovite
- Montmorillonite
- Nontronite
- Pyrope
- Sphene

- Chalcedony

Reading the Samson dataset in .mat format and representing image of each band is as shown in Figure 2.

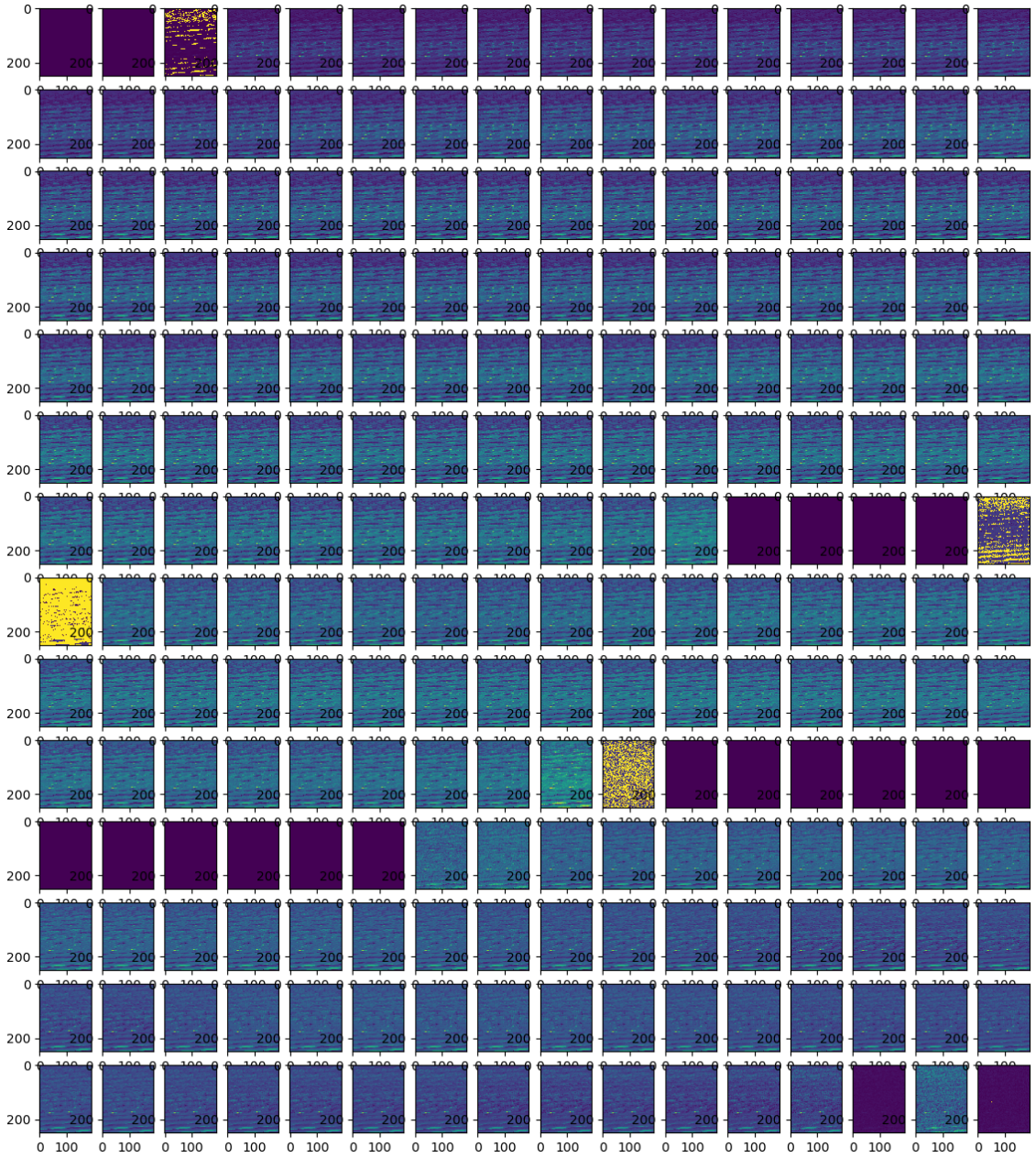

Figure 3: Images of all 224 bands in Cuprite Dataset

3 Literature Review

3.1 Linear Mixing Model:

The linear unmixing problem is composed of three main steps,

1. Dimension reduction
2. Endmember determination
3. Estimation of endmember spectra and fractional abundance

In Linear Mixing Model, it is assumed that the mixture of the contributions of the materials is linear which in real world is not plausible [1].

4 Work to be done

1. Literature review on Non linear method
2. Selecting a architecture and starting scratch implementation of the same

References

[1] Rob Heylen, Mario Parente, and Paul Gader. A review of nonlinear hyperspectral unmixing methods. *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, 7(6):1844–1868, 2014.

[2] N. Keshava and J.F. Mustard. Spectral unmixing. *IEEE Signal Processing Magazine*, 19(1):44–57, 2002.