

Special Topics in Applications (AIL861)

Artificial Intelligence for Earth Observation

Lecture 21

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Hyperspectral Images

- ❑ Multispectral images capture a few relatively broad wavelength band
- ❑ Hyperspectral images collect image data simultaneously in dozens or hundreds of narrow, adjacent spectral bands
- ❑ These measurements make it possible to derive a continuous spectrum for each image cell

Pro and Con

Pro: very detailed spectral information of the scene

Con: trade-off between spectral and spatial resolution

Uses

- ❑ Distinguish between different types of soil, dry/wet soil
- ❑ Distinguish between different types of water, clear lake water/ turbid river water
- ❑ Distinguish between different minerals
- ❑ Distinguishing plants (normal grass / dry yellowish grass)

Spectral Library

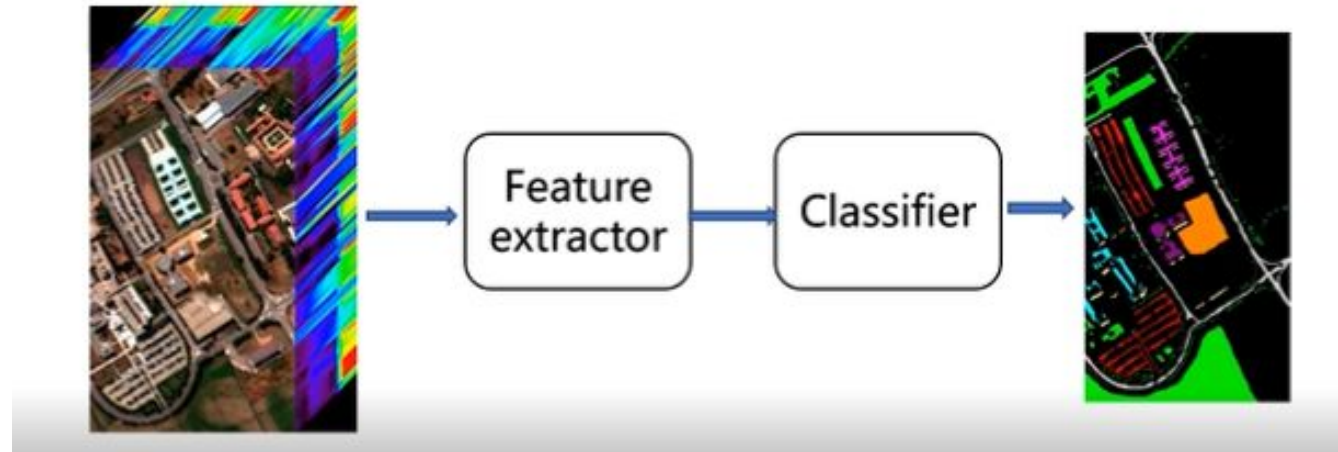
Spectral libraries provide a source of reference spectra that can aid the interpretation of hyperspectral and multispectral images.

E.g. ASTER Spectral Library

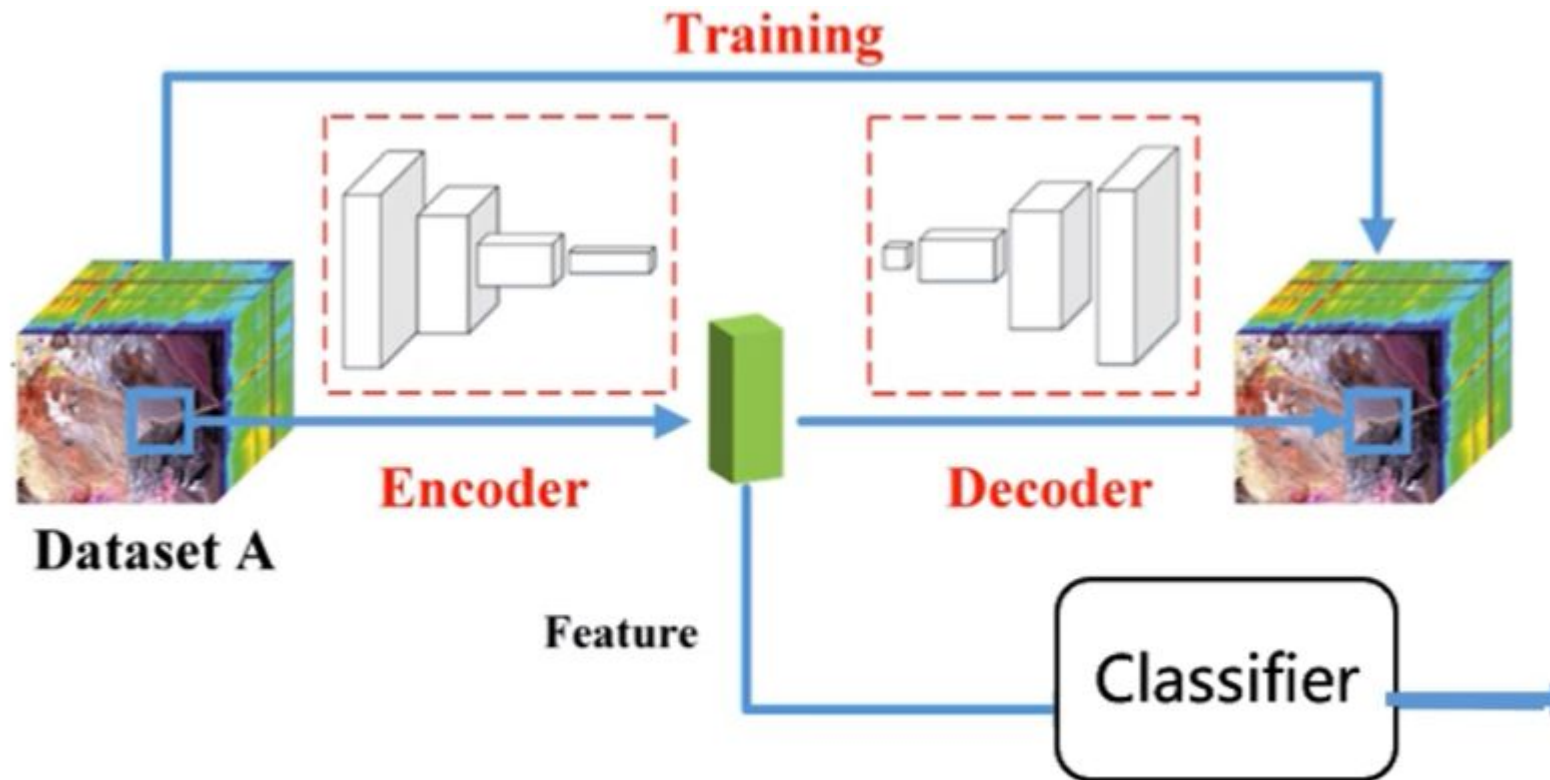
[http:// speclib.jpl.nasa.gov](http://speclib.jpl.nasa.gov)

Hyperspectral Classification

Pixel wise classification (better called as semantic segmentation)

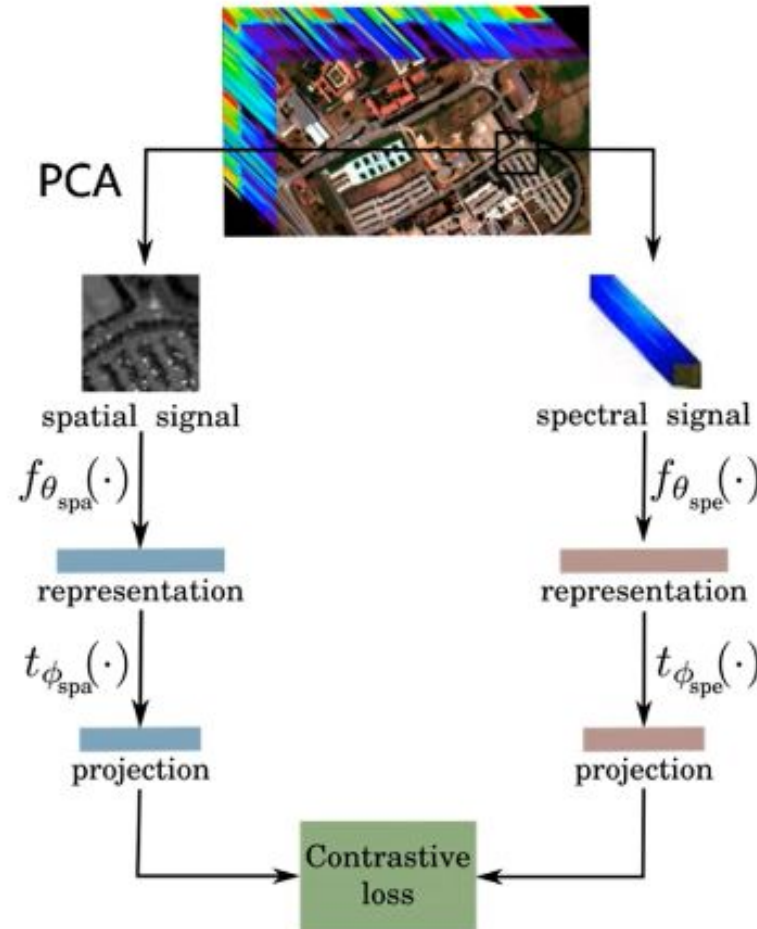


Hyperspectral Classification



Unsupervised Spatial–Spectral Feature Learning by 3D Convolutional Autoencoder for Hyperspectral Classification

Spatial-Spectral Contrastive Learning



Positive data: spatial and spectral data of signals of same neighborhood

Negative data: spatial and spectral signals of different neighborhood

Hyperspectral - Multispectral Fusion

- ❑ Get the best of two modalities.
- ❑ Traditionally pansharpening: decompose correlated bands into a set of uncorrelated bands and then replace the band with the highest variance with the panchromatic band.
- ❑ Deep learning based methods, early fusion, decision fusion, intermediate fusion.

Semi-Supervised Learning

- ❑ A few labeled data along with a larger pool of unlabeled data.
- ❑ Popular for hyperspectral image analysis.
- ❑ A popular approach for semi-supervised learning is graph neural network.

GNNs in Hyperspectral Image Analysis

A. Qin, Z. Shang, J. Tian, Y. Wang, T. Zhang, Y. Y. Tang, Spectral-spatial graph convolutional networks for semisupervised hyperspectral image classification, IEEE Geoscience and Remote Sensing Letters, 2018.

S.Wan, C. Gong, P. Zhong, B. Du, L. Zhang, J. Yang, Multiscale dynamic graph convolutional network for hyperspectral image classification, IEEE Transactions on Geoscience and Remote Sensing 58 (5), 2019.

X. Tong, J. Yin, B. Han, H. Qv, Few-shot learning with attention-weighted graph convolutional networks for hyperspectral image classification, in: IEEE International Conference on Image Processing (ICIP), IEEE, 2020.

Ye, Z., Sun, T., Shi, S., Bai, L. and Fowler, J.E., Local–Global Active Learning Based on a Graph Convolutional Network for Semi-Supervised Classification of Hyperspectral Imagery. IEEE Geoscience and Remote Sensing Letters, 20, pp.1-5, 2023.