HybridSN: Exploring 3-D–2-D CNN Feature Hierarchy for Hyperspectral Image Classification
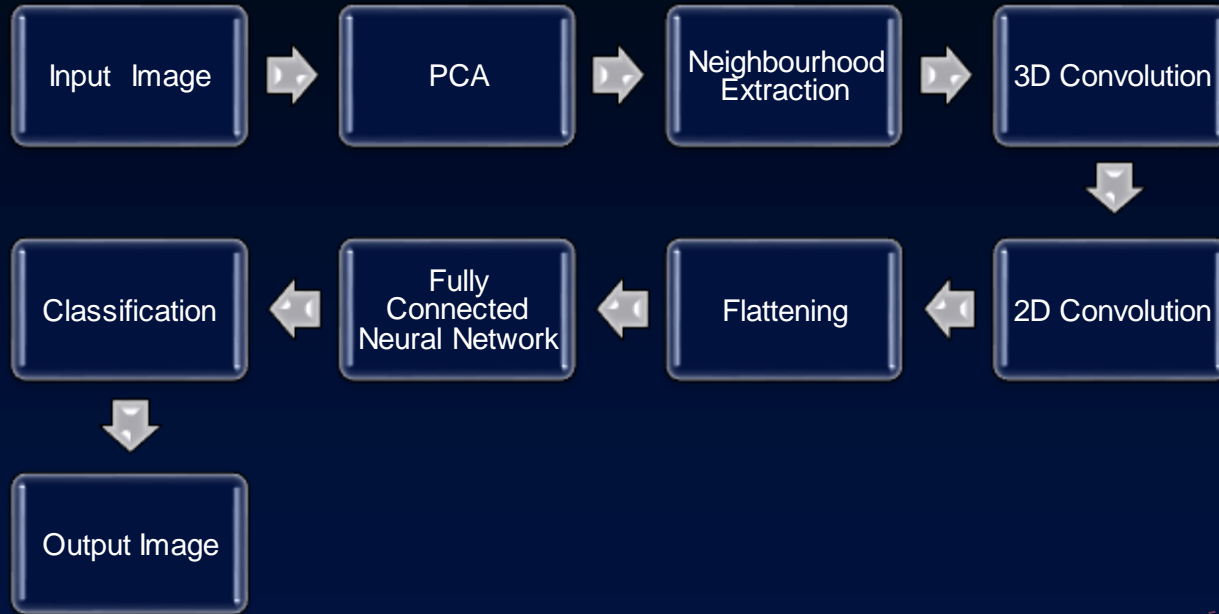
Methodology

Input Image → PCA → Neighbourhood Extraction → 3D Convolution → 2D Convolution → Flattening → Fully Connected Neural Network → Classification → Output Image
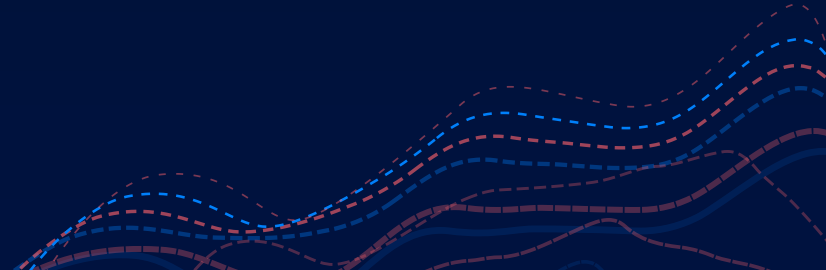
Work Flow
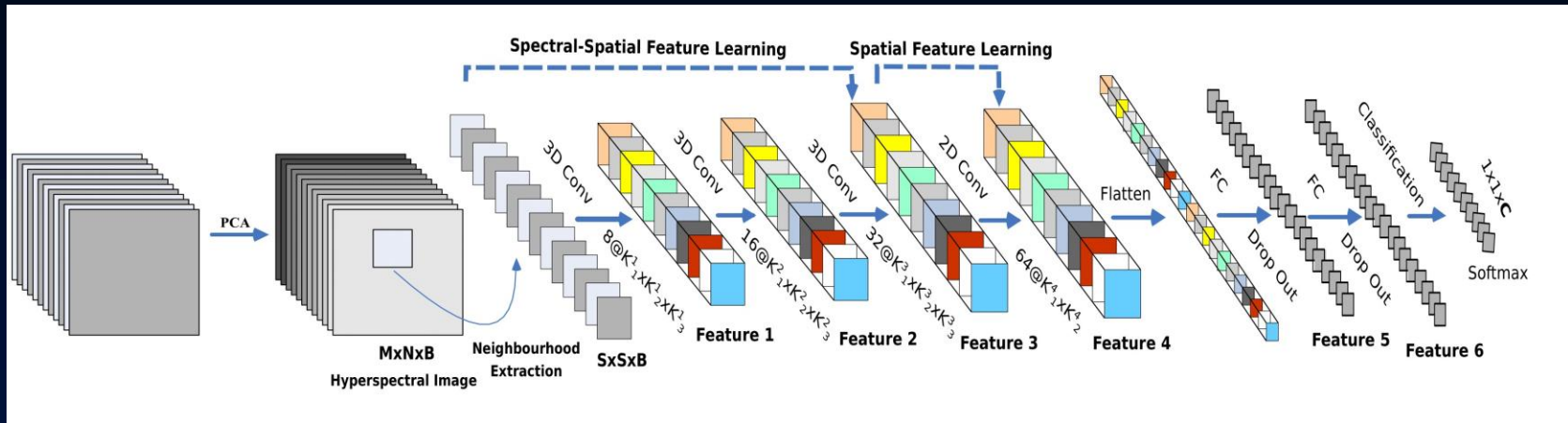
Reference

Principal Component Analysis

❑ It is a statistical method used to reduce the dimensionality of a dataset by finding the most important features or components that explain the most variance in the data.

❑ The goal of PCA is to transfer a dataset of possibly correlated variables into a set of uncorrelated variables, called principal components, that retain most of the information of the original dataset.

❑ This is achieved by finding the eigenvectors and eigenvalues of the covariance matrix of the dataset.
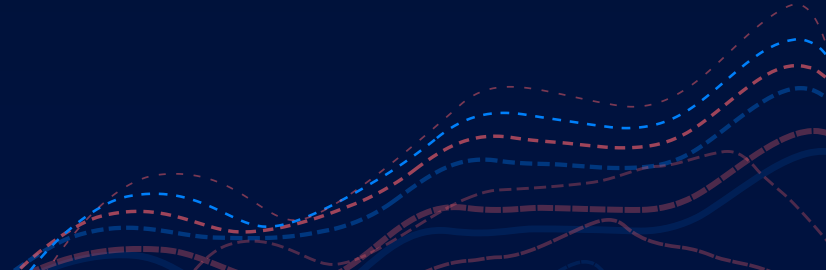
Convolutional Neural Network

❑ CNN consists of multiple layers like the input layer, Convolutional layer, Pooling layer, and fully connected layers.

❑ CNN models to train and test, each input image will pass it through a series of convolution layers with filters (Kernels), Pooling, fully connected layers (FC) and apply Softmax function to classify an object with probabilistic values between 0 and 1.
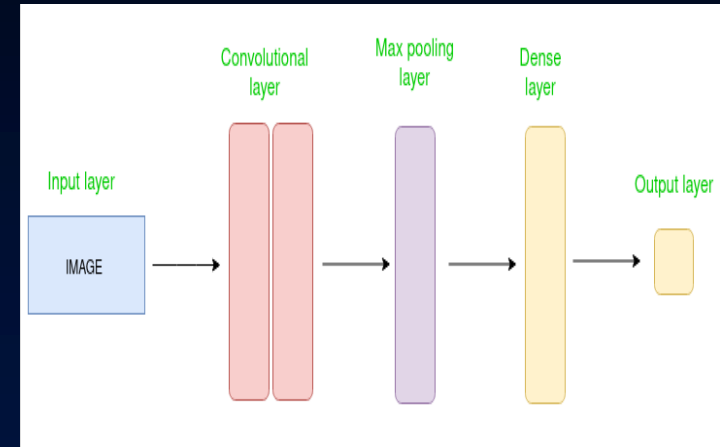

Reference

Hybrid Spectral CNN

❑ Hybrid Spectral CNN is a spectral-spatial 3-D-CNN followed by spatial 2-D-CNN.

❑ The 3-D-CNN facilitates the joint spatial-spectral feature representation from a stack of spectral bands.

❑ The 2-D-CNN on top of the 3-D-CNN further learns more abstract-level spatial representation.

❑ Moreover, the use of hybrid CNNs reduces the complexity of the model compared to the use of 3-D-CNN alone.
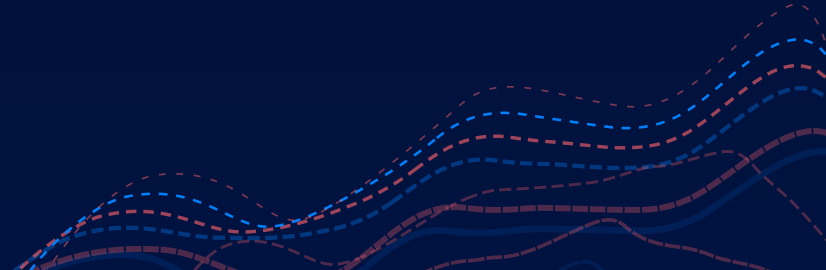
Dataset Description

❑ Input Data : HSI data set is Indian Pines (IP).

❑ IP data set has images with 145×145 spatial dimension and 224 spectral bands in the wavelength range of 400 to 2500 nm, out of which 24 spectral bands in the wavelength range of 400 to 2500 nm.

❑ out of which 24 spectral bands covering the region of water absorption have been discarded. The ground truth available is designated into 16 classes of vegetation

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Classification Results
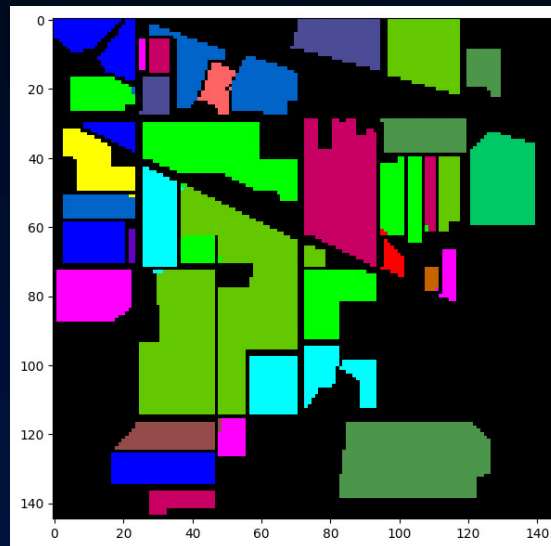
Conclusion

❑ Hybrid SN is based on the hierarchical representation of spectral–spatial 3-D-CNN followed by a spatial 2-D-CNN, which are complementary to each other.

❑ The proposed Hybrid SN model basically combines the complementary information of Spatio-spectral and spectral in the form of 3-D and 2-D convolutions, respectively.

❑ The proposed model is computationally efficient than the 3-D-CNN model. It also shows the superior performance for small training data.

Reference

❑ https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8736016&tag=1

❑ https://github.com/gokriznastic/HybridSN/blob/master/supplementary-material.pdf

Thank You