Advanced Pattern Recognition and Transfer Learning Techniques for Hyperspectral Image Segmentation

Nibedan Banerjee[1] and Debayudh Mitra[2]

[1] *Institute of Engineering and Management,India*
[2]*Institute of Engineering and Management,India*

[1]banerjeenibedan@gmail.com
[2]bdebayudhmitra@gmail.com

Abstract

This research project focuses on advancing the field of hyperspectral image segmentation through a comprehensive comparative study of pattern recognition models and the exploration of state-of-the-art transfer learning techniques. The study aims to enhance the accuracy and efficiency of image segmentation on hyperspectral datasets, specifically Indian Pines, Salinas, and Pavia University.

In the first phase of the project, we conduct a comparative analysis of pattern recognition models applied to hyperspectral image segmentation. Three distinct models, namely PCA+SBS+RF, PCA+CNN, CNN, and PCA+KNN, are evaluated on the selected datasets. Principal Component Analysis (PCA) is employed for dimensionality reduction, Sequential Backward Selection (SBS) is used for feature selection, and Random Forest (RF), Convolutional Neural Network (CNN), and K-Nearest Neighbors (KNN) serve as the pattern recognition models. The study aims to identify the most effective combination for accurate hyperspectral image segmentation.

In the second phase, the project explores the application of transfer learning using well-established Convolutional Neural Network (CNN) architectures, including ResNet50, InceptionV3, DenseNet121, MobileNetV3. These models are fine-tuned and adapted for hyperspectral image segmentation on the same datasets. Transfer learning leverages the pre-trained knowledge of these deep architectures on large-scale image datasets, potentially enhancing the performance of hyperspectral image segmentation tasks.

The performance of each model and transfer learning technique is systematically evaluated based on criteria such as segmentation accuracy, computational efficiency, and robustness across diverse hyperspectral datasets. The research findings will contribute to the identification of optimal models for hyperspectral image segmentation, paving the way for improved remote sensing applications, environmental monitoring, and precision agriculture. The project's outcomes will provide valuable insights into the selection and customization of pattern recognition and transfer learning models for hyperspectral image analysis in various real-world scenarios.

Keywords: *Hyperspectral image segmentation, Pattern recognition models, Convolutional Neural Network (CNN), Transfer learning, Comparative study*