Project Abstract

Topic - Dimensionality reduction and Multilabel classification of high dimensional hyperspectral images using Spectralnet algorithm

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Problem Statement
Some image sets, particularly in case of hyperspectral remote sensing, can be of dimension extending into hundreds. The spectral features do have redundancy, so efficient dimensionality reduction algorithms are an active area of research. A comparison of some of the popular evolutionary algorithms for feature selection is the aim of the topic.

Industry - Analysis of Earth observation imagery

Domain - Image Processing,Healthcare, Agriculture

Motivation - The computational costs can be reduced significantly if we can classify images with low dimension feature sets and lot of useful applications in the domain of agriculture and health, these techniques can be used to compute different attributes of an image and give predictions to farmers about crop quality etc real time so that they are more prepared.

A good starting point: "Remote Sensing Digital Image Analysis" by J.A. Richards and X. Jia, Springer.

Introduction
Hyperspectral sensors measure energy in narrower and more numerous bands than multispectral sensors. So, the dimension of features is sometimes set into hundreds. There is a redundancy of features that are obtained from hyperspectral remote sensing data. So, our task is to eliminate the correlated features and give a representative feature set of the image without any data loss (ie) projecting the data to a lower dimensional subspace which captures the “essence” of the data. We have to find an efficient dimensionality reduction algorithm for our task. Some of the most used dimensionality reduction algorithm include

1. Principal Component Analysis(PCA)
2. Particle Swarm Optimisation(PSO)
3. Singular Value Decomposition (SVD)
4. Linear Discriminant Analysis (LDA)
5. Isomap Embedding
6. Locally Linear Embedding
7. Modified Locally Linear Embedding

So, a comparative analysis between various dimensionality reduction algorithms is carried out on the chosen hyperspectral image feature set.

Research Methodology

We will go through the basic literature out there for implementation of dimensionality reduction on high dimensional images, and understand different techniques that one can employ.Then, We will understand the kind of image data that we are working on and map it to the existing literature,then do some preprocessing of the data. It will help us give a fair idea of the feature set. We will study all the possible and implementable optimisation algorithms which are used for dimensionality reduction for high dimensional images and then implement one after another on a sample image. Based on the chosen metric to analyse the output of the dimensionality reduction feature set, we will choose the possible algorithm/model for the data which can give the most optimum solution without any loss in data.

Timeline

Literature review - **2 days**
Data set selection - **1 day**
Preprocessing of data - **1 day**
Understanding the application of algorithms to the domain selected - **1day**
Writing the complete end to end code and Selecting models and tuning the hyperparameters for various models chosen - **5 days**
Performance analysis - **2 days**
Report writing - **2 days**

References

Richards, J. A., & Richards, J. A. (1999). *Remote sensing digital image analysis* (Vol. 3, pp. 10-38). Berlin: Springer.

Ayesha, S., Hanif, M. K., & Talib, R. (2020). Overview and comparative study of dimensionality reduction techniques for high dimensional data. *Information Fusion*, *59*, 44-58.

Alhayani, B., & Ilhan, H. (2017). Hyper spectral image classification using dimensionality reduction techniques. *International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering*, *5*, 71-74.

Mohan, A., Sapiro, G., & Bosch, E. (2007). Spatially coherent nonlinear dimensionality reduction and segmentation of hyperspectral images. *IEEE Geoscience and Remote Sensing Letters*, *4*(2), 206-210.