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Hyperspectral Image Classification using Minimum Noise Fraction and Random Forest

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Abstract— ***Remote sensing technology is improving day by day which has also increased the uses of hyperspectral imaging tremendously. Exact classification of ground features from hyperspectral images is an important and a popular research area and also have attracted a widespread of attention. A good classification results are achieved by many methods for the classification of hyperspectral imaging. This paper focuses on classification of hyperspectral image using different machine learning techniques like support vector machine (SVM), random forest (RF), polynomial logistic regression (LR), K-Nearest Neighbour (KNN) and decision tree (DT). Principal Component Analysis (PCA) and Minimum Noise Fraction (MNF) have been used to reduce the un-necessary and noisy bands present in the dataset.***

Keywords— Hyperspectral imaging; SVM; RF; KNN; DT; remote sensing; principal component analysis (PCA); Minimum Noise Fraction (MNF)

I. INTRODUCTION

The availability of hyperspectral remote sensing images with high spatial and spectral resolution are begun to available in recent years. As these hyperspectral images have strong angular resolution for a spectra, these images have a wide range of applications such as in environment [1], mining [2], military [3] and medical fields [4]. Imaging spectrometers are the main sources for the acquisition of hyperspectral images which are installed at particular places. The imaging spectrometer acquires images in many continuous and narrow bands due to which each pixel of the image gets a spectrum of reflected wavelength range which was used during acquiring of image. Hence hyperspectral images have high spectral resolution with many bands and plentiful data. The pre-processing of these hyperspectral image includes dimensionality reduction [5], noise reduction [6], transformation [7], and image correction [8]. Dissimilar to the RGB images the hyperspectral images are abundant with spectral information which contain the physical formation and chemical configuration of the object of interest which is useful for image classification.

Computer classification of hyperspectral image is an application of pattern recognition technique in the field of remote sensing. As with the time the development of hyperspectral imagers will be evident which will be able to produce more detailed and valuable data. On one hand we have a high spatial data whereas on the other side we have spectral resolution with significant improvement. With further development in the imagers the data containing hyperspectral images will be huge and the range of uses of the hyperspectral data will be expanded. In comparison with multi spectral images, the number of wavelength bands are higher in hyperspectral images and ability to sort out objects is higher. Still due to high dimensionality of hyperspectral data the classification of this data still faces a chain of challenges, mainly of following problem that need to be resolved [9,10].

The hyperspectral data have high dimensionality, as the data is collected majorly from an air-borne or space -borne spectrometers in many hundreds of bands due which the resulting image also contains hundreds of dimensions of the corresponding spectral image.

Spectral information of spatial variability, affected due to various factors such as atmospheric conditions, sensors, composition and distribution of ground features.

Quality of image, while acquiring the hyperspectral image the involvement of noise and background factors hampers the quality of data which directly affects the classification accuracy of the model.

From the earlier research of hyperspectral image classification, researchers were focused mainly on the spectral data of the image, and from this spectral data many classification methods were developed such as Support Vector Machine (SVM) [11], random forest (RF), polynomial logistic regression [12]. Dimension reduction technique for feature extraction and selection also been preferred, such as principal component analysis (PCA) [13, 14] and linear discriminant analysis (LDA) [15].

The image classification methods of hyperspectral data are classified into supervised classification [16-18] and unsupervised classification [19, 20] on the basis of

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