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Review and Study on Feature Extraction of Hyperspectral Images

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Abstract- Feature extraction is known to be an effective way in both reducing computational complexity and increasing accuracy of Hyperspectral image classification. In this proposed work, a simple yet quite powerful feature extraction method based on image fusion is proposed. First, the hyper spectral image is partitioned into multiple subsets of adjacent hyper spectral bands. Then, the bands in each subset are processed by using image fusion. The fused bands are processed with transform domain recursive filtering to get the resulting features for classification. The method will be design to get performance in terms of classification accuracy and computational efficiency.

Index Terms- Hyperspectral Images, Feature Extraction, Image Fusion, Recursive Filtering, Image Classification.

1. INTRODUCTION

Work on Hyperspectral images is in recent trend. The high spectral images are extracted with hyper-spectral satellite sensors, such as the Airborne Visible/Infrared Imaging Spectrometer (AVIRIS). Before use of hyper spectral images, from the 1970s, multispectral images are in use.

Hyperspectral images are spectrally over determined; they provide sample spectral information to identify and distinguish between spectrally similar (but unique) materials. Hyper spectral image also provides the potential for more accurate and detailed information extraction than is possible with other types of remotely sensed data. Hyper spectral Images also provide detailed spectral information regarding the physical nature of the materials and thus can be used to distinguish different landscapes.

However, for developing efficient methods to process hyper spectral images with more than 100 channels is a difficult objective. The high dimensionality are also brings the problem named as "Hughes phenomenon" which will influence the classification performance. In order to solve these problems, feature selection and extraction are known to be important techniques in hyper spectral image classification.

2. LITERATURE REVIEW AND RELATED WORK

M. Pal and G. M. Foody [1] authors proposed SVM based features selection methods classification of hyper spectral data. For the classification SVM are used ,remotely sensed data with some claims that the method is insensitive to the Dimensionality of the data and so not requiring a dimensionality reduction analysis in pre-processing. A dependency of the accuracy of classification by a SVM on the dimensionality of the data and so the potential value of undertaking a feature selection analysis prior to classification. Feature selection may be a valuable analysis to include in pre-processing operations for classification by a SVM.

S. B. Serpico and G. Moser [2] introduced for classification purposes they used Extraction of spectral channels a procedure to extract spectral channels of variable bandwidths and spectral positions from the hyper spectral image for optimize the accuracy for a specific classification problem. Each spectral channel ("s-band") is obtained by averaging a group of contiguous channels of the hyper spectral image ("h-bands"). For formalization of the problem makes it analogous to a feature-selection problem, the three strategies have been derived by modifying three feature-selection strategies, namely 1) the "sequential forward selection," 2) the "steepest ascent," and 3) the "fast constrained search."

S. Backer, P. Kempeneers, W. Debruyn, and P. Scheunders [3] they adapted Spectral classification based on band selection technique, they explained hyper spectral remote sensing where sensor acquire reflectance values at many various wavelength bands for covering a spectral interval. These find out measurements are strongly correlated to each other, and no new information might be added when increasing the spectral resolution.

L. Bruzzone and C. Persello [4] presented the approach to feature selection for the classification of hyper spectral images..The feature selection is accomplished by defining multi objective criteria on function made up of two terms: 1) a term that measures the class separability and 2) a term that evaluates the spatial invariance of the selected features

M. Pedergnana, P. R. Marpu, M. D. Mura, J. A. Benediktsson, and L. Bruzzone [5] was introduced Optimal feature selection in attribute profiles based on genetic algorithms .Morphological and attribute profiles have been proven to be effective tools to fuse spectral and spatial information for classification of remote sensing data.. In this paper, they introduce a novel iterative technique based on genetic algorithms (GAs) is proposed to automatically optimize the selection of the optimal features from the profiles.

J. Benediktsson, M. Pesaresi, and K. Amason [6] proposed Morphological transformations based Classification and feature extraction. Classification of panchromatic high-resolution data from urban areas using morphological and neural approaches was proposed by. They proposed in three steps. Firstly, they discuss about the composition of geodesic opening and closing operations of different sizes. Feature extraction or feature selection is used in the second step. Both discriminate analysis feature extraction and decision boundary feature extraction are investigated in the second step along with a simple feature selection based on picking the largest indexes of the differential morphological profiles. In third step, a neural network is used to classify the features from the second step.

K. He, J. Sun, and X. Tang [7] the author proposed a removal of Single image haze. They introduced a simple image prior which can be used in dark channel prior. The dark channel prior is a kind of statistics of outdoor haze-free images. They also shows it is based on their key observation the most local patches in outdoor haze-free images contain some pixels intensity is very low in at least one colour channel.

C. H. Lin, J. S. Tsai, and C. T. Chiu [8] based on switching bilateral filter (SBF) with a texture and noise detector for universal noise removal Operation was carried out in two stages. In first stage they include important features such as edge or texture information. That information is utilized to allocate a reference median from SQMV then it compared with a current pixel to classify it as impulse noise, Gaussian noise. In second step, the SBF removes both Gaussian and impulse noise without adding another weighting function.

X. Kang, S. Li, and J. A. Bendiktsson [9] proposed the integration of spatial context in the classification of hyper spectral images is known to be an effective way in improving classification accuracy. The framework consists of the following three steps. In First step by using a pixel-wise classifier the hyper-spectral image is classified, such as the support vector machines classifier. Then, the resulting classification map is represented as multiple probability maps and edge-preserving filtering is conducted on each probability map with the first principal component or the first three principal components of the hyper spectral image serving as the gray or colour guidance image.

The Literature Review as as shown as following table,

Table 1: Literature Review

Sr. No.	Authors	Year	Used echnique/Al orithm	Limitation
01	M. Pal and G. M. Foody	2010	SVM based features selection methods classificati on of hyper spectral data.	Recursive filtering not attended
02	S.B. Serpico and G. Moser	2007	For classificati on purposes they used Extraction of spectral channels	Computati onal accuracy is very less.
03	S.Backe r, P. Kempe neers, W. Debruy n, and P. Scheun ders	2005	Spectral classificati on based on band selection technique	Complexit y of data is very high.
04	Bruzzo ne and C. Persello	2009	Spatially invariant features for the classificati	Feature selection and feature extraction not

			on of hyper spectral image.	attended.
05	M. Pedergnana, P. R. Marpu, M. D. Mura, J. A. Benediktsson, and L. Bruzzone	2013	Optimal feature selection in attribute profiles based on genetic algorithms.	Computational time is more
06	J. Benediktsson, M. Pesaresi, and K. Amason	2003	Morphological transformations based Classification and feature extraction.	Computational efficiency and accuracy are very less.
07	] K. He, J. Sun, and X. Tang	2011	Removal of Single image haze.	Computational time is more.
08	C. H. Lin, J. S. Tsai, and C. T. Chiu	2010	Switching bilateral filter with a texture/noise detector for universal noise removal.	Computational complexity is more.
09	X. Kang, S. Li, and J. A. Bendiktsson	2013	Spectral–spatial hyper spectral image classification with edge-preserving filtering,	Recursive filtering not attended

3. ANALYSIS OF PROBLEM

High spectral images captured using sensors such as the Airborne Visible/Infrared Imaging Spectrometer (AVIRIS) provide detailed spectral information regarding the physical nature of the materials and thus can be used to distinguish different landscapes. However, developing efficient methods to process hyper spectral images with more than 100 channels is a difficult objective.

Hyper spectral images contain thousands of bands that provide the highest class separability form that finding the best subset is the major problem. Selecting the best subset of data without disturbing the physical meaning of the data is the challenge. The preservation of the spatial information is also quite important for feature selection and performing selection on the hyper spectral image.

Hyper spectral images shows detailed information about spectral images so the resulting expected outcomes are taking too many times so it suffering from the high dimensions of the data and increasing the computational complexity of the data. To reduce dimensions of data and complexity of data is another issue in feature selection & extraction of an image.

Hence a method is required to extract features of the hyper-spectral image while impacting its spatial information too. At the same time think about computational accuracy and efficiency.

4. PROPOSED WORK

Our objective is to reduce the computational dimensionality and increase the accuracy of the data by the use of recursive filtering to combine spatial information into the resulting features. The proposed method carried out by using feature extraction and classification approach consists of following steps:

- The hyper spectral image are partition into multiple subsets of adjacent bands,
- The adjacent bands are fuse in each subset,
- Perform Recursive filtering
- Perform Classification.

Hyper spectral image band should be filtered first then performed recursive filtering.

Proposed system will mainly deal with following research techniques to successful completion of the system, the following figure shows the flow chart for our approach**.**

- **Project Flow**

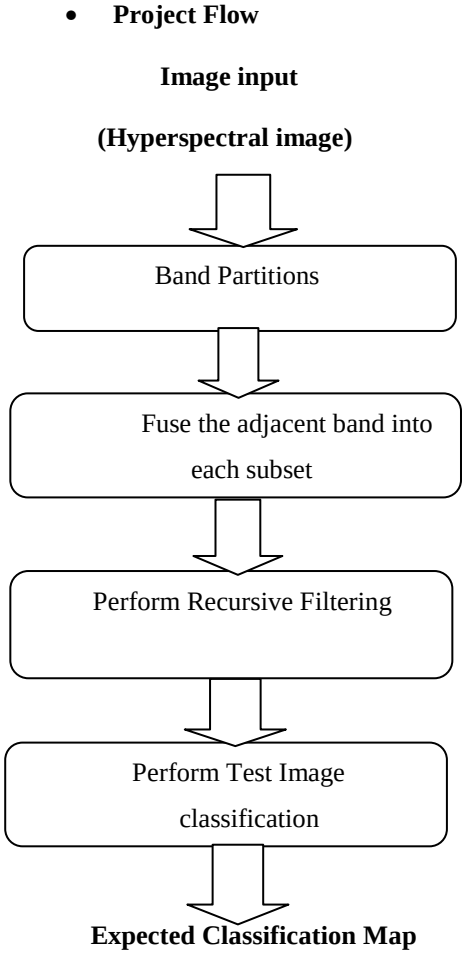

Fig.1.Block Diagram of Proposed Approach

The above Fig. 1 shows the flow chart of proposed system to implement feature extraction of hyper spectral images by using HRF algorithm

The proposed flow contained the following points,

1) ***Input Test Images:***

Hyper spectral Images are used in for input test image.

2) ***Band partitioning:***

First,, the hyper spectral image is spectrally partitioned into *Kth* subsets of adjacent bands.

3) ***Fuse the adjacent Band:***

After the band portioning of the Hyper spectral image into adjacent bands then the adjacent bands in the *k*th subset are fused by Brovey Transformation and Principle Component Analysis.

4) ***Perform Recursive filtering:***

Then used Transform domain Recursive Filtering is performed on each fused band to obtain the *k*th feature.

5) ***Perform Classification:***

The SVM classifier is utilized for the classification of the Image Fusion and Recursive Filtering features. The SVM classifier is one of the most widely used pixel wise classifiers and has, in particular, shown a good performance in terms of classification accuracy. Furthermore, the SVM classifier has a major advantage, i.e., robust to the dimension of data sets. Therefore, in this situation, the classification result of the SVM method for an original data set can be considered in providing the best pixel wise classification results.

5. CONCLUSION

We have proposed a new approach to implement feature extraction hyper spectral image by using the HRF. The proposed approach is based on the Hybrid Fusion, the use of recursive filtering and SVM classifier which is used to reduced the dimensionality and complexity of the data and also increasing the accuracy of data

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