Research and contributions in hyperspectral image classication using articial intelligence techniques

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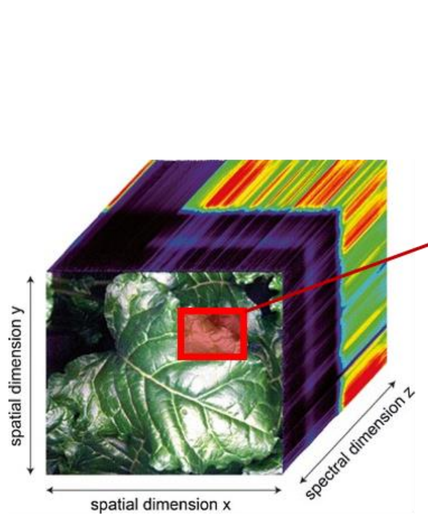
Introduction

The hyperspectral images are defined by the spectral information and the spatial dimension. Due to the fact that the hyperspectral data is characterised by information stored along the spatial and spectral dimensions, different methods were integrated in a classifications chain in order to determine the different types of materials with high accuracy.



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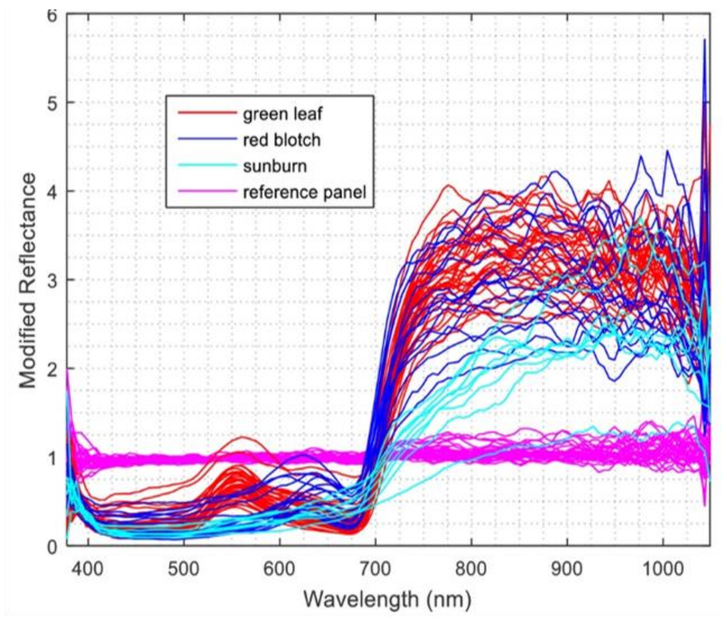
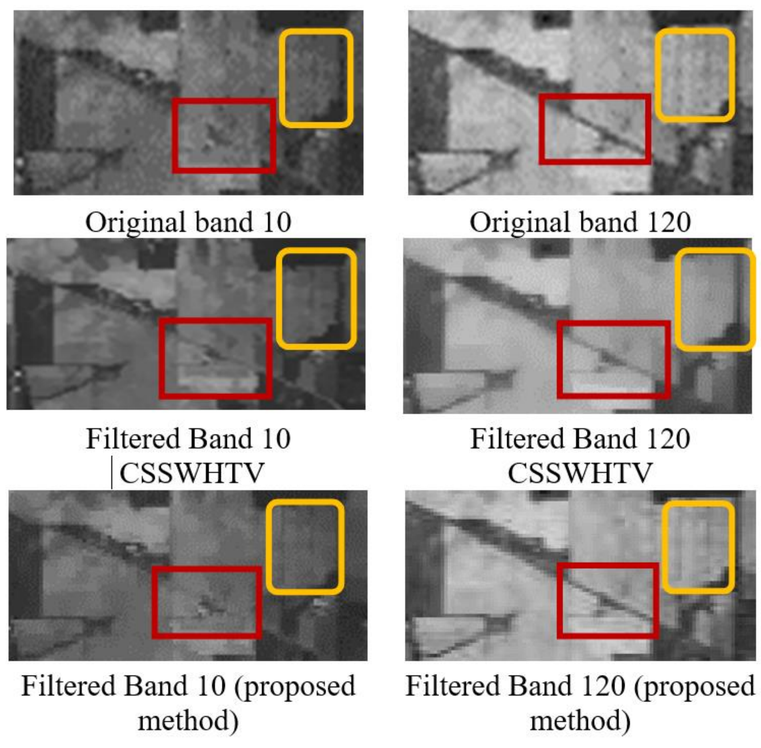


Research Directions

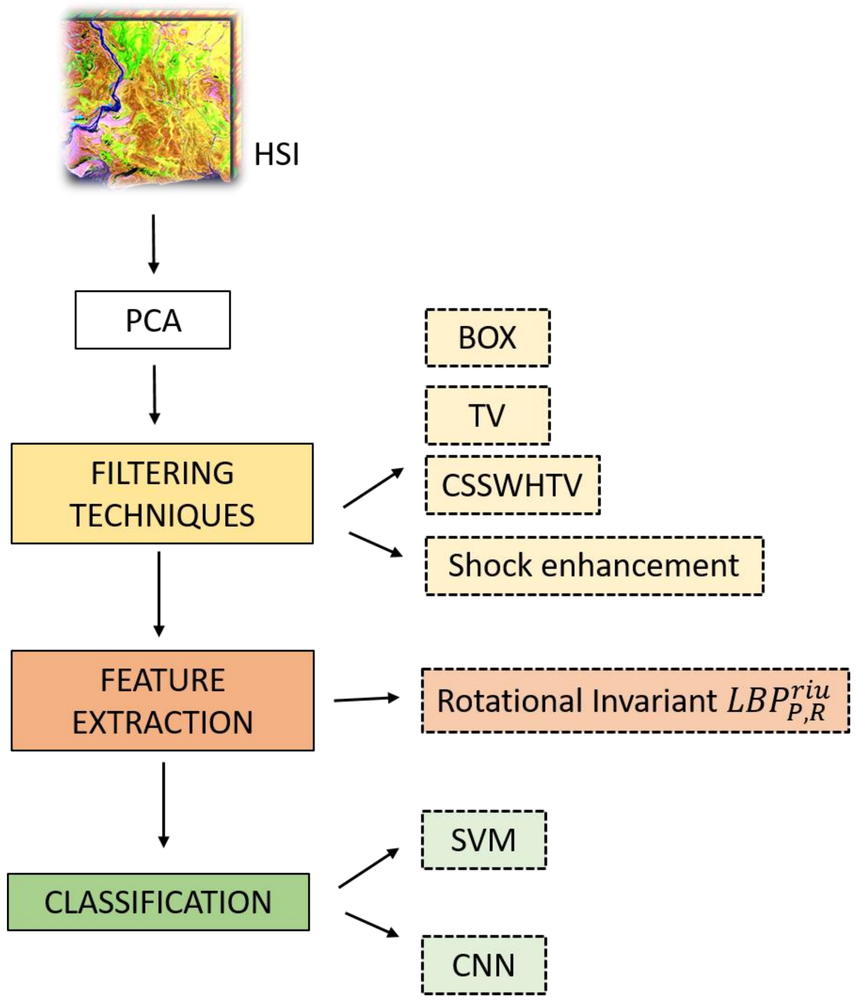
- Study of new methods and operators for noise removal based on the correlation between the spatial and spectral dimensions.
- Study of new methods and operators for texture extraction based on the correlation between the spatial and spectral dimensions.
- Study of new architectures for hyperspectral classication based on the 3D format of the data.
- Designing and implementing an image classication chain with performance assesement based on the sensibility of the parameters.

Filtering Techniques

1. **Hyperspectral Image Classification using Combined Spectral-Spatial Denoising and Deep Learning Techniques:** the denoising strategy considered is based on the adaptive total variation method capable of alleviating the difficulty of removing the noise while preserving textures and edges. This approach, lies in the adaptive regularization terms in both the spatial and spectral dimensions.
2. **Hyperspectral Image Enhancement using Diffusion and Shock Filtering Techniques:** the method is developed under the Partial Differential Equations framework and has good noise filtering, details preservation and enhancement capabilities. Its efficiency is proven both in terms of visual means and in terms of overall classification accuracy.



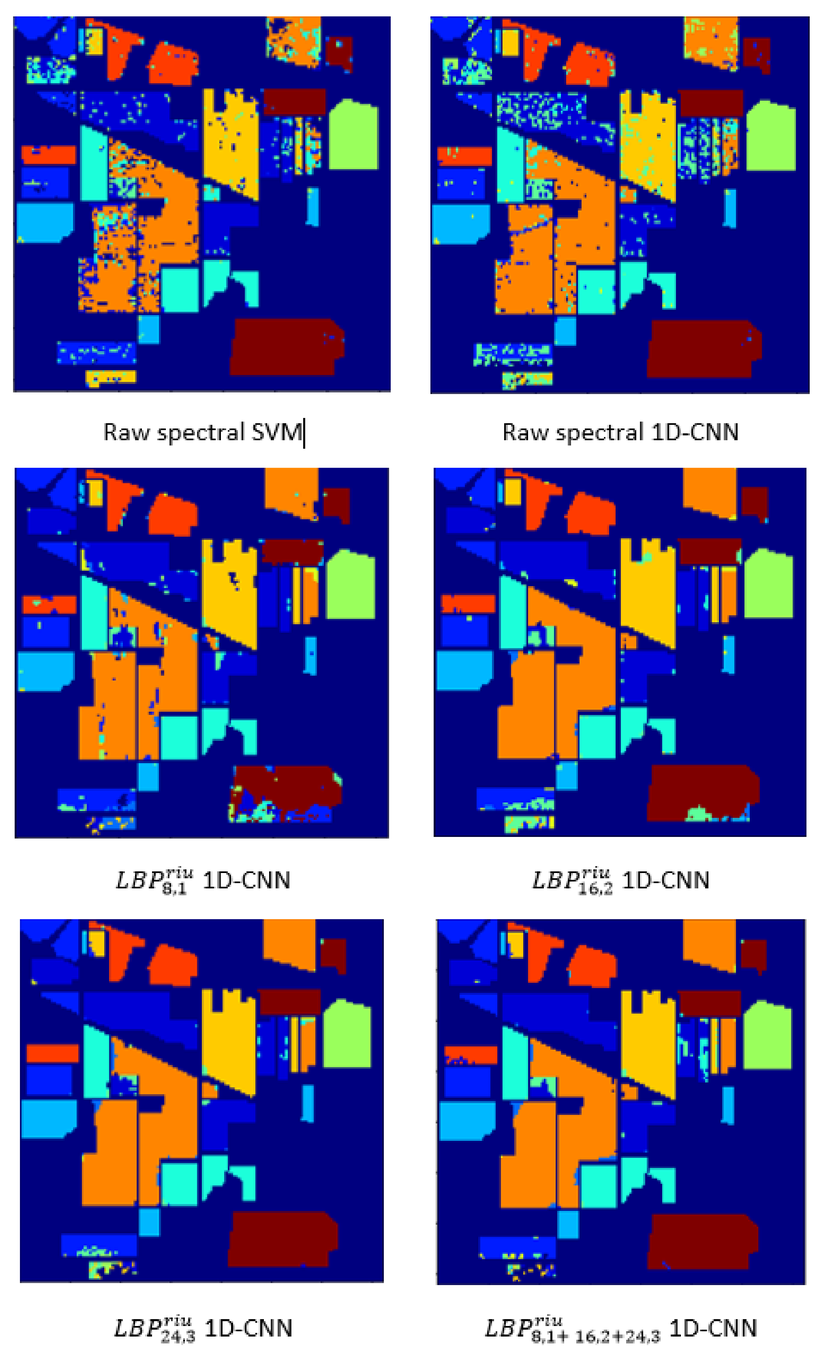
	Indian Pines		
	3 SAMPLES	5 SAMPLES	10 SAMPLES
Spectral data	39.20± 3.27	40.00± 1.85	45.50± 2.78
LBP	57.97± 2.32	67.30± 3.48	77.26± 1.42
Channel coupling method	47.58± 2.89	53.42± 2.94	66.87± 1.15
CSSWHTV method	58.74± 5.1	69.21± 1.74	77.61± 5.19
Proposed filtering method	**61.96± 2.68**	**69.70± 5.19**	**79.70± 1.98**



Feature Extraction

One dimensional convolutional neural networks and local binary patterns for hyperspectral image classification: the proposed model is based on one dimensional convolutional network (1D-CNN) applied over the histograms obtained from the rotational invariant local binary pattern technique. The experimental results demonstrate that the proposed method can improve the accuracy on different data sets even with a limited number of training samples.

	Indian Pines LBP 1D-CNN		
	200 training samples	300 training samples	400 training samples
$LBP^{riu}_{8,1}$	89.44 ± 1.05	91.27 ± 1.23	92.68 ± 1.51
$LBP^{riu}_{16,2}$	93.83 ± 0.75	95.27 ± 0.91	95.50 ± 1.27
$LBP^{riu}_{24,3}$	95.39 ± 0.34	95.44 ± 0.88	96.71 ± 0.38
$LBP^{riu}_{8,1+\ 16,2+24,3}$	94.70 ± 0.72	95.32 ± 1.02	95.92 ± 0.47



Future work

Despite the increase in performance of the proposed classification chain, a deeper analysis on how the methods can be improved presents a great interest. The future work will represent also the analysis of different use of different descriptors that can perform in a pseudo-3D manner on the preprocessed data sets, methods that can jointly extract important features from the correlated spatial-spectral domains.

ACKNOWLEDGMENT

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