SOUTENANCE DE THÈSE

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soutiendra sa thèse de doctorat

sur le sujet :

Band Selection in Hyperspectral Images

Le jeudi 27 septembre 2018 à **13h30**
A l'université de technologie de Compiègne
Amphi L103 – Centre Pierre Guillaumat

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Résumé :

Hyperspectral images (HSIs) are capable of providing a detailed spectral information about scenes or objects under analysis.
It is possible thanks to both numerous and contiguous bands contained in such images. Given that different materials have distinct spectral signatures, objects that have similar colors and shape can be distinguished in the spectral domain that goes beyond the visual range.

However, in a pattern recognition system, the huge amount of data contained in HSIs may pose problems in terms of data storage and transmission.
Also, the high dimensionality of hyperspectral images can cause the overfitting of the classifier in case of insufficient training data.
One way to solve such problems is to perform band selection (BS) in HSIs, because it decreases the size of the dataset while keeping both useful and original information.

In this thesis, we propose three different band selection frameworks.
The first one is a supervised one, and it is designed to use only 20 of the available training data. For each class in the dataset, a binary one-versus-all classification using a single-layer neural network is performed, and the bands linked to the largest and smallest coefficients of the resulting hyperplane are selected.
During this process, the most correlated bands with the bands already selected are automatically discarded, following a procedure also proposed in this thesis. Consequently, the proposed method may be seen as a class-oriented band selection approach,
allowing a BS criterion that meets the needs of each class.

The second method we propose is an unsupervised version of the first framework.
Instead of using the class information, the K-Means algorithm is used to perform successive binary clustering of the dataset. For each pair of clusters, a single-layer neural network is used to find the separating hyperplane, then the selection of bands is done as previously described.

For the third proposed BS framework, we take advantage of the unsupervised nature of autoencoders.
During the training phase, the input vector is subjected to masking noise\textemdash some positions of this vector are randomly flipped to zero\textemdash and the reconstruction error is calculated based on the uncorrupted input vector.
The bigger the error, the more important the masked features are.
Thus, at the end, it is possible to have a ranking of the spectral bands of the dataset.