NLPCA APPLICATIONS FOR THE SPECTRAL COMPRESSION AND DENOISING OF MULTIVARIATE IMAGES

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A general approach for the compression of multivariate data is based mainly on the removal of redundancies and suppression of noise. From this point of view, in the literature, there exist many methods for the decorrelation of multivariate data in order to represent the intrinsic information content in a lower dimensionality domain. The most popular feature extraction method for data representation is Principal Component Analysis (PCA), where a set of uncorrelated transformed features is generated. Since these features are ranked in terms of variance, it is possible to suppose that the components featuring the lowest variances could be related to noise, thus the dimensionality reduction can be obtained by discarding those components and reprojecting the remaining ones back into the data space. However, since PCA and similar methods are linear, this approach may be invalid in case on data featuring nonlinear correlation. Thus, it is desirable to use nonlinear transformations in order to extract more information. Many methods have been proposed to extract component in a nonlinear manner, such as locally linear embedding (LLE), Isomap and self-organizing maps (SOM). However, the main limitation of these methods is related to the low number of resulting features that may be not sufficient to describe the inherent information of the data. Nonlinear generalizations of the standard PCA, nonlinear PCA (NLPCA) and kernel PCA (KPCA) present a higher degree of freedom in terms of feature dimensionality. Both techniques are able to provide similar mapping functions. However, the main advantage of NLPCA over KPCA is the invertibility of the mapping function, allowing the NLPCA to provide denoised reconstructions of the original data.

In this work we will introduce the ability of the NLPCA to deal with different types of multivariate images, such as hyperspectral, multi-energy x-ray, SEM and Raman images, removing noise as well as other degrading artifacts.

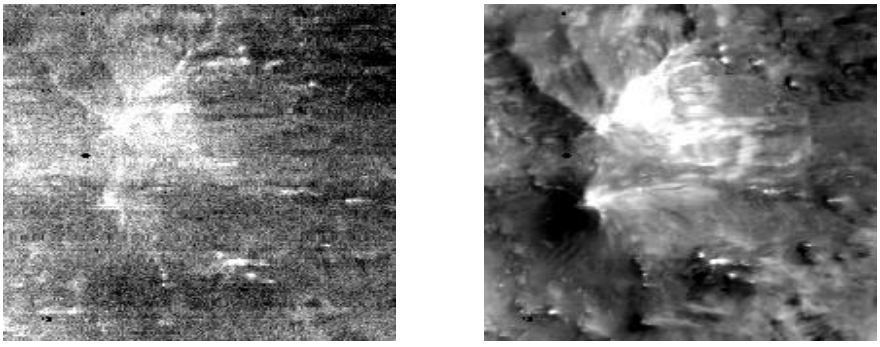

Fig. 1: Example of the denoising performed by using NLPCA on a hyperspectral image