Some projection pursue techniques for unsupervised target detection in hyperspectral imageries

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Abstract:

A hyperspectral image can be modeled with a Euclidean space where the number of bands is the dimension of the space and the pixels in the image are represented as points in that space. Our presentation is focused on the detection of anomalies, which are considered as targets (objects or materials) whose signatures are spectrally distinct from their background, with no *a priori* knowledge of the target's spectral signature. In this respect, the detection of anomalies in hyperspectral images is equivalent to detecting outliers in the feature space.

Therefore, the only available option is to look for objects that are differentiated from the background in an unsupervised manner. We do that by looking for one-dimensional projections (projection pursuit) optimizing some measurement of interest (index). This has been done already for several indexes [1], [2], [3]; here we analyze a new index — minimal variance — and compare it with skewness and kurtosis and with the popular RX technique. The optimation for the plane projection is performed with a genetic algorithm. The algorithms are tested in synthetic images and AHS hyperspectral imageries. It is shown how each index has its properties and characteristics and how they are complementary to some degree. Following the work already done by the authors [4] in visualization techniques for anomaly detection, combining low components of PCA and RX, in this presentation the new index for minimal variance will be analyzed.

References

[1] D. Manolakis, G. Shaw, Detection algorithms for hyperspectral imaging applications. IEEE Signal Processing Magazine, 19(1) pp 29-43, 2002.

[2] S. Chiang, C. Chang, Unsupervised target detection in hyperspectral images using projection pursuit, IEEE Trans. Geosci. Remote Sensing 39(7) pp 97 1380-1391, 2001.

[3] J. A. Malpica, J. G. Rejas, M. C. Alonso. A projection pursuit algorithm for anomaly detection in hyperspectral imagery. Pattern Recognition 41 (11) pp: 3313-3327, 2008.

[4] M. C. Alonso and J. A. Malpica. The combination of three statistical methods for visual inspection of anomalies in hyperspectral imageries. Proceeding of the Seventh International Conference on Advances in Pattern Recognition, pp. 377-380, 2009.