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ESTIMATION FOR VIRTUAL DIMENSIONALITY OF HYPERSPECYRAL IMAGERY

Determination of intrinsic dimensionality (ID) for remotely sensed imagery is a challenging problem. According to the definition given in Fukunaga (1990, p. 280), the ID, also referred to effective dimensionality, is the minimum number of parameters required to account for the observed properties of the data. A general approach to ID estimation is principal components analysis (PCA) that makes use of the eigenvalue distribution to determine ID. This approach may be suitable to multispectral imagery since only a small number of bands are used and the resulting ID is expected to be small. However, the PCA method can be difficult to implement if it is applied to hyperspectral imagery. More importantly, it may not be effective even if it is applicable. With very high spectral resolution hyperspectral sensors which can extract many unknown subtle material substances, determining ID of hyperspectral imagery is more problematic than that of multispectral imagery. In order to account for such unknown signal sources, we introduce a new definition, referred to as virtual dimensionality (VD) in this chapter, which is the minimum number of spectrally distinct signal sources that characterize the hyperspectral data from a perspective view of target detection and classification. These signal sources may include unknown interfering sources, which cannot be identified by *a priori* knowledge. With this new definition, three eigen-thresolding based methods are presented to determine VD of hyperspectral imagery. They are all derived from the Neyman-Pearson detection theory. Since an information criterion (AIC) and the minimum description length (MDL) have been commonly used in sensor array processing to estimate the number of signals impinging upon the array, they will be also investigated and evaluated for comparison.