Matrix and Tensor Methods and Variational Methods in Hyperspectral Image Analysis

Bob Plemmons
Wake Forest University, USA

Nonnegative matrix factorization, nonnegative tensor factorization, and variational segmentation methods have recently been successfully used for dimensionality reduction, classification, and spectral mixture analysis for identification of the materials present in hyperspectral images. In this talk, we first present a new variant of NMF called Nonnegative Matrix Underapproximation (NMU): it is based on the introduction of underapproximation constraints which enables one to extract features in a recursive way, like PCA, but preserving nonnegativity. Moreover, we explain why these additional constraints make NMU particularly well-suited to achieve a parts-based and sparse representation of the data, enabling it to recover the constitutive elements in hyperspectral data. This is joint work with Nicolas Gillis. We also provide an overview of joint work with Fang Li and Michael Ng on the use of variational methods for the analysis of hyperspectral data. Noise and blur can present serious data analysis problems. In this regard, we couple fuzzy segmentation with a hyperspectral image data denoising/deblurring model and propose this method as an alternative to a matrix and tensor factorization methods.

We experimentally show the effectiveness of these strategies on hyperspectral images associated with space object material identification, and on HYDICE and related remote sensing images.

Joint work with Nicolas Gillis, Fang Li, and Michael Ng.