ACCOUNTING FOR SPECTRAL VARIABILITY IN HYPERSPECTRAL UNMIXING USING BETA ENDMEMBER DISTRIBUTIONS

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ABSTRACT

Two approaches based on the Beta Compositional Model are presented in this thesis for hyperspectral spatial-spectral unmixing (i.e., finding the proportions of each endmember in a hyperspectral image). The two approaches considered are using either Quadratic Programming (QP) optimization or a Metropolis-Hastings (MH) sampler in order to incorporate endmember spectral variability during unmixing. The QP approach determines the proportion values by minimizing the difference between the mean of Beta approximation to the convex combination of Beta endmember distributions, while the MH sampling method takes both the mean and variance into consideration.

The unmixing algorithms in the thesis that incorporate spatial information leverage the Fuzzy Local Information C-Means Clustering Algorithm (FLICM), superpixel methods, and spatial K-means algorithms.

Results indicate that unmixing algorithms based on the BCM are able to successfully perform unmixing on simulated data and real hyperspectral data and can incorporate endmember spectral variability. BCM unmixing does a better job than the previously studied Normal Compositional Model (NCM) unmixing on data generated from Beta endmembers than those from Gaussian endmembers. The results from BCM-Spatial unmixing algorithms on hyperspectral image data show that the new algorithms are effective at unmixing.