Title: Hyperspectral Unmixing Based on Mixtures of Dirichlet Components

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Abstract: This paper introduces a new unsupervised hyperspectral unmixing method conceived to linear but highly mixed hyperspectral data sets, in which the simplex of minimum volume, usually estimated by the purely geometrically based algorithms, is far way from the true simplex associated with the endmembers. The proposed method, an extension of our previous studies, resorts to the statistical framework. The abundance fraction prior is a mixture of Dirichlet densities, thus automatically enforcing the constraints on the abundance fractions imposed by the acquisition process, namely, nonnegativity and sum-to-one. A cyclic minimization algorithm is developed where the following are observed: 1) The number of Dirichlet modes is inferred based on the minimum description length principle; 2) a generalized expectation maximization algorithm is derived to infer the model parameters; and 3) a sequence of augmented Lagrangian-based optimizations is used to compute the signatures of the endmembers. Experiments on simulated and real data are presented to show the effectiveness of the proposed algorithm in unmixing problems beyond the reach of the geometrically based state-of-the-art competitors.

Author Keywords: Augmented Lagrangian Method of Multipliers; Blind Hyperspectral Unmixing; Dependent Components; Generalized Expectation Maximization (GEM); Minimum Description Length (MDL); Mixtures of Dirichlet Densities

KeyWords Plus: Nonnegative Matrix Factorization; Endmember Extraction; Constrained Optimization; Algorithm; Imagery; Model; Recovery

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