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Abstract Title: A General Framework for Group Sparsity in Hyperspectral Unmixing Using Endmember Bundles

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Due to low spatial resolution, hyperspectral data often consists of mixtures of contributions from multiple materials. This limitation motivates the task of hyperspectral unmixing (HU), a fundamental problem in hyperspectral imaging. HU aims to identify the spectral signatures (*endmembers*) of the materials present in an observed scene, along with their relative proportions (*fractional abundance*) in each pixel. A major challenge lies in the class variability in materials, which hinders accurate representation by a single spectral signature, as assumed in the conventional linear mixing model. To address this issue, we propose using group sparsity after representing each material with a set of spectral signatures, known as endmember bundles, where each group corresponds to a specific material. In particular, we develop a bundle-based framework that can enforce either inter-group sparsity or sparsity within and across groups (SWAG) on the abundance coefficients. Furthermore, our framework offers the flexibility to incorporate a variety of sparsity-promoting penalties, among which the transformed ℓ_1 (TL1) penalty is a novel regularization in the HU literature. Extensive experiments conducted on both synthetic and real hyperspectral data demonstrate the effectiveness and superiority of the proposed approaches.