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Algorithm for Improved Differentiable Hyperspectral Unmixing

Background

Hyperspectral unmixing—a method of imaging where light radiance is densely sampled at multiple wavelengths—is an important remote sensing task with applications including material identification and analysis. Characteristic spectral features make many pure materials identifiable from their visible-to-infrared spectra, but quantifying their presence within a mixture is a challenging task due to nonlinearities and factors of variation.

Invention Description

Researchers at Arizona State University have developed a hyperspectral unmixing algorithm for improved performance in material identification and classification. Spectral variation is considered from a physics-based approach and incorporated into an end-to-end spectral unmixing algorithm via differentiable programming. The dispersion model is introduced to simulate realistic spectral variation, and an efficient method to fit the parameters is developed. Then, this dispersion model is utilized as a generative model within an analysis-by-synthesis spectral unmixing algorithm. When training data is available, performance and speed is further enhanced by an inverse rendering technique that uses a convolutional neural network to predict parameters of the generative model. Results achieve state-of-the-art on both infrared and visible-to-near-infrared (VNIR) datasets, and show promise for the synergy between physics-based models and deep learning in hyperspectral unmixing.

Potential Applications

- Remote sensing
- Aerial hyperspectral imaging for agriculture, minerology, and land surveying
- Deep learning

Related Publication: Differentiable Programming for Hyperspectral Unmixing using a Physics-based Dispersion Model

Research Homepage of Professor Suren Jayasuriya

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