



Hyperspectral Unmixing

Hyperspectral unmixing is a field where it extracts useful information from a hyperspectral data set – 3D data cube which includes spatial information and reflectance values at different frequency levels. Generally, since hyperspectral images are captured by satellites, a hyperspectral sensor does not render higher spatial resolution compared to its spectral resolution. Therefore, the measured reflectance is often a mixture of spectral signatures of the underlying materials. In this regard, Hyperspectral unmixing is quite imperative because unmixing algorithms are capable of decomposing a mixed pixel into a collection of endmembers (spectral signatures of the pure materials) and corresponding abundances (fractional weights of each endmember). Hyperspectral image and relevant unmixing algorithms data has been extensively used in remote sensing, as it allows us to identify and analyze material in an image. Hence, over the past few decades, considerable effort has been utilized in developing hyperspectral unmixing (HU) methods, hence many algorithms have been introduced in order to solve the HU problem.

Key results :

Due to numerous obstacles such as atmospheric interferers, multiple scattering and nonlinearity, finding the exact endmembers and abundances are laborious. Different approaches have been identified and as a result, many researches are focused on imposing auxiliary regularizes on the conventional nonnegative matrix factorization (NMF) framework in order to effectively unmix these mixed spectra. In addition, Geometric algorithms, minimum volume transform, sparse regression methods are ubiquitous in this field. Moreover, In the recent past, deep learning-based methods have been proposed for HU because they exploit the nonlinearity behaviours of the mixed pixels.

The researchers were able to introduce two new NMF based premises to obtain accurate source signals. In the "Graph-Based Blind Hyperspectral Unmixing via Nonnegative Matrix Factorization" paper, it describes how to use the inherent characteristic - in a close spatial neighbourhood the abundances of an endmember tend to be similar to each other - of a typical hyperspectral dataset to extract physical properties of the constituents. And the independence nature of the endmembers is employed in the papers "Constrained Nonnegative Matrix Factorization for Blind Hyperspectral Unmixing incorporating Endmember Independence" and "Enhanced Hyperspectral Unmixing via Non-Negative Matrix Factorization Incorporating the End Member Independence", which enables to obtain accurate endmember spectra. Furthermore, various DL architectures have been scrutinized for higher accuracy of the unmixing process, and as a result, a convolutional based unmixing method is introduced in the paper "Convolutional Autoencoder for Blind Hyperspectral Image Unmixing".

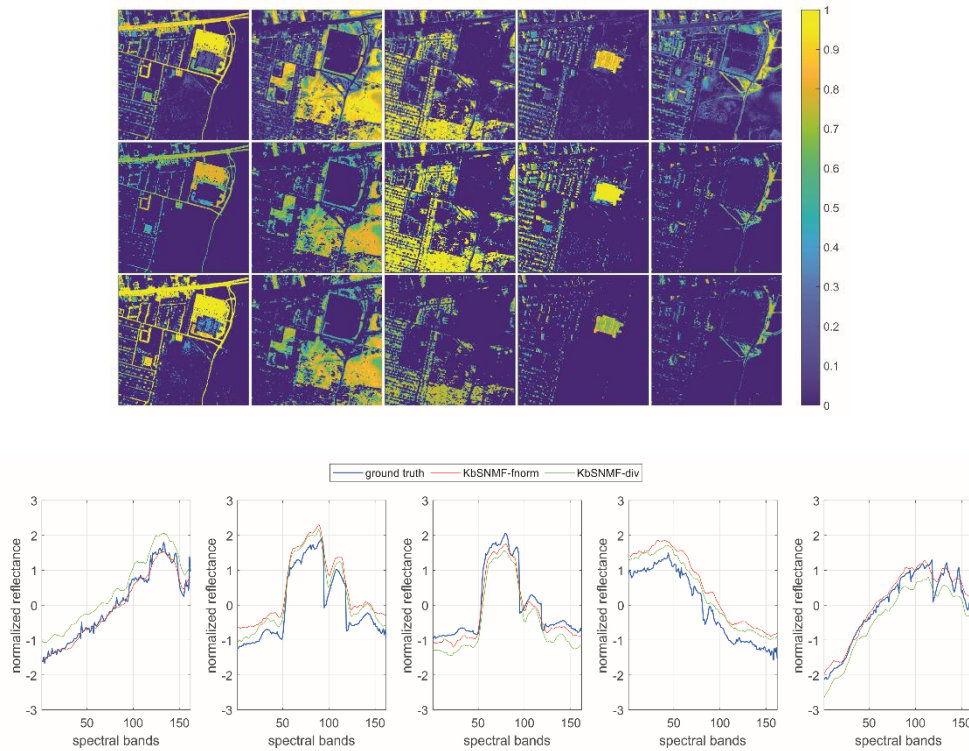


Fig. Extracted abundances and endmember spectra utilizing the KbSNMF algorithm

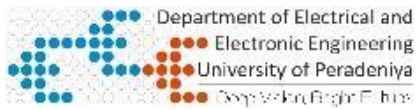
Outcomes :

- B. Rathnayake, E. M. M. B. Ekanayake, K. Weerakoon, G. M. R. I. Godaliyadda, M. P. B. Ekanayake and H. M. V. R. Herath, "Graph-Based Blind Hyperspectral Unmixing via Nonnegative Matrix Factorization," in IEEE Transactions on Geoscience and Remote Sensing, vol.58, no. 9, pp. 6391 – 6808, September, 2020.
- E. M. M. B. Ekanayake and H. M. H. K. Weerasooriya and D. Y. L. Ranasinghe and S. Herath and B. Rathnayake and G. M. R. I. Godaliyadda and M. P. B. Ekanayake and H. M. V. R. Herath "Constrained Nonnegative Matrix Factorization for Blind Hyperspectral Unmixing incorporating Endmember Independence", in IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, 2021
- D.Y.L. Ranasinghe, H.M.S Lakmal, H.M.H.K. Weerasooriya, E.M.M.B Ekanayake, G.M.R.I Godaliyadda, H.M.V.R. Herath, M.P.B. Ekanayake, "Convolutional Autoencoder for Blind Hyperspectral Image Unmixing," in proceedings of 15th IEEE International Conference on Industrial and Information Systems (ICIIS-2020), IIT Ropar, India, November, 2020.
- Mevan Ekanayake; Bhathiya Rathnayake; Hasantha Ekanayake; Anusha Rathnayake; Vijitha Herath; Roshan Godaliyadda; Parakrama Ekanayake; "Enhanced Hyperspectral Unmixing via Non-Negative Matrix Factorization Incorporating the End Member Independence", in IEEE International Geoscience and Remote Sensing Symposium (IGARSS-2019), Yokohama, Japan, August, 2019.

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