DEEP LEARNING FOR HYPERSPECTRAL UNMIXING AND CLASSIFICATION IN REMOTE SENSING APPLICATIONS

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Abstract

Hyperspectral Image (HSI) analysis is one of the rapidly expanding fields in remote sensing due to the utilization in many practical applications in a large number of projects. The reflectance values of an HSI depend mainly on the type of material (chemical composition) and its physical structure. Hence, HSIs are widely used in many applications such as feature detection in human faces, object identification, food quality detection, surveillance, biomedical applications, and identification of minerals. Agriculture is one of the key sectors where HSIs are used for a variety of applications. HSI analysis provides an opportunity to develop fast and non-invasive methods of detecting plant species and potentially discriminating between different types without human annotations. Modern HSIs convey a large amount of data in terms of spectral and spatial information, posing many challenges in the analysis and interpretation of these data. Deep learning approaches certainly offer a great variety of opportunities for solving classical imaging tasks and also for approaching new stimulating problems in the spatial-spectral domain. Deep learning techniques are attaining tremendous success compared to traditional machine learning techniques in numerous fields, owing to their ability to automatically learn hierarchical features from the raw input data. In contrast to domains such as object recognition, where deep learning has far outrun traditional machine learning techniques, deep learning is less popular among the researchers in the HSI domain. This is mainly due to the data scarcity and computational constraints when processing higher dimensional HSIs. However, the efficient and effective design of deep learning algorithms would solve the above hindrances. The principal aim of our work was to develop methods to improve HSI unmixing and classification methodologies using deep learning techniques. The developed models were evaluated on their ability to detect plant species and potentially discriminating between different types using the HSIs which were acquired from various online HSI databases. The results suggested that the proposed models outperformed several state-of-the-art algorithms with respect to HSI unmixing accuracy.

Keywords: Hyperspectral unmixing (HU), hyperspectral classification, deep learning, remote sensing