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Unmixing-based feature extraction for mineral mapping

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Hyperspectral imaging is a well-accepted technology for mineral mapping. However, the advantage of using hyperspectral data for this purpose depends on the applied techniques. Spectral unmixing and classification algorithms have been widely applied in the literature to map and determine different minerals composition. Generally, these two algorithms are used independently, however, in the scientific community dedicated to the field of land cover classification, new techniques have been developed in which, both classification and spectral unmixing are used complementarily. For example, spectral unmixing techniques have been used for feature extraction prior to a supervised classification. This strategy has been explored to address the problem of mixed pixels, which are dominant in hyperspectral images. Previous studies concluded that using unmixing-based features do not particularly improve classification accuracies in comparison to applying the extracted features by a classic algorithm such as the Minimum Noise Fraction (MNF). However, the advantage over this is that features extracted from spectral unmixing techniques have physical meaning since they can be interpreted as the abundances of the materials present in the scene, and they do not relegate variations of features with less significant signal-to-noise ratio, therefore, small classes are better characterized. Nevertheless, in geological remote sensing applications, the use of spectral unmixing as a feature extraction technique prior to a supervised classification has not been previously applied.

In this context, this work proposes the use of an automatic endmember extraction algorithm (e.g., Vertex Component Analysis – VCA) to further obtain the mineral abundances at a sub-pixel scale with a linear unmixing process. These features are subsequently used as inputs to a standard supervised classification technique (e.g., Support Vector Machine – SVM). The experiments are carried out on a hyperspectral VNIR/SWIR dataset of core samples. With this technique, we introduce a novel supervised approach, which, based on preliminary attempts, is expected to deliver both qualitative and quantitative improvements in the final classification accuracies.