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A subspace clustering algorithm with spatial regularization for mineral mapping

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Determination of the mineral compositions of an ore deposit is a vital task in exploration campaigns. Hyper-Spectral (HS) imaging is an emerging technology that is becoming popular in the mining industry. Specially, analyzing drill core HS data enables geologists to map minerals in mining projects in a fast and non-destructive manner. There are several methods to analyze the acquired drill cores. While traditional approaches such as X-Ray diffraction (XRD) can be subjective and are time consuming, the new machine learning based techniques applied on drill core HS scans have shown promising results. By using machine learning techniques, geologists are able to identify representative areas of drill core samples to apply traditional laboratory analysis.
In recent studies, advanced unsupervised learning techniques to cluster HS data have shown great performance. Specially subspace clustering methods (i.e. sparse subspace clustering, low rank representation clustering) obtained more accurate results than the traditional clustering methods (e.g. K-means) for the analysis of this data. This is mainly because of the fact that each pixel may contain several minerals rather than a single phase. Therefore, the drill core HS data can be better represented as a union of low dimensional subspaces.
In this work, we propose a new subspace-based method to cluster drill core HS data. It has been shown in the literature that incorporating spatial information will improve the classification results of HS data. Thus, in this work, we suggest including spatial information in the sparse subspace clustering method. In the classical sparse clustering method, only spectral information being used to cluster HS data. While, by adding information from the surrounding of each pixel in the classical sparse formula, the performance of the subspace clustering method will be improved. The method was applied to VNIR-SWIR hyperspectral data. Qualitative validation was provided by scanning electron microscopy based Mineral Liberation Analysis (SEM-MLA) on some areas of interest. Results indicate that the proposed method is promising, compared to existing clustering methods.