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Identification of rocks using a hyperspectral supercontinuum lidar

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In the future ore bodies remaining for mining will commonly have low grades and the valuable metals will more likely occur as refractory or trace minerals. Mining will require means to reduce waste production and energy consumption by more selective mining operations and by utilization of remotely controlled and intelligent underground technologies. Remote technology will not only be necessary for the production efficiency but also for coping with occupational safety and scarcity of skilled labour force. However, the development of automation and remote control requires further research of fast positioning, image interpretation and surveying of the excavations.

Consequently, a general trend in mining technology has been to integrate mineralogical and geological ore characterization methods to the mine planning and the optimization of mineral processing. This involves 3D predictive spatial modelling of the distribution not only the ore grade and mineralogy but also the geological and metallurgical and mining technical parameters within a deposit that effect the mining operations. The physical properties of rocks and mining technical parameters are obtained by time-consuming field mapping and standardized laboratory experiments. Since the physical properties of rocks commonly correlate with their mineral composition, texture and grain size and consequently, with the hyperspectral characteristics. Therefore, spectral methods and distinction of the spectral fingerprints can be expected to support substantially mining geological investigations.

In this presentation, the usefulness of a hyperspectral supercontinuum lidar was investigated as a tool for classification of rock type and discrimination the samples based on their spectral fingerprint. The utilization of the spectral data is based on different classification algorithms and to the determination of representative reference categories. The methods used were: Spectral angle mapper, distance classification, spectral correlation mapper, canonical discriminant analysis, cluster analysis and principal component analysis.

The spectral angle mapper and the spectral correlation mapper gave the weakest results. The distance classification and the cluster analysis were both able to classify the rocks with over 95 percent accuracy. The canonical discriminant analysis gave the best results with a classification accuracy of over 99 percent. The principal component transformation was used to exam the effects of dimension reduction of the data. The reduction from eight original variables to three principal components reduced the accuracy of the cluster analysis only with less than one percentage point.

The results of this study were encouraging and they suggest that in the future, these new methods could be a part of geometallurgical mapping in mines and real-time rock quality control in rock aggregate production.

References:

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