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Mechanical characterization of rock samples using hyperspectral remote sensing

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In this research, the geotechnical quality of rock masses is investigated by means of hyperspectral remote sensing techniques. Geological engineering projects such as tunneling, supporting unstable rock slopes, or natural hazards assessments, require evaluation of the quality of the rock mass using existing classification systems. As rock mass is composed of an assemblage of rock material that is separated by rock discontinuities, the existing rock mass classification systems relies on information about mechanical behavior of the intact rock material and the spatial distribution of rock discontinuities.
In recent decades, remote sensing technologies have been used as data acquisition methods for geological mapping of regions without physical contact with the areas being explored. The use of technologies such as photogrammetry and LiDar scanning allow geologists to efficiently build large 3D models of rock structures that can then be utilized for assessing stability issues in rock masses. Significant progress in geology remote sensing has been achieved through hyperspectral remote sensing technology. These advances enable the identification and recognition of objects based on the spectral absorption features of a specific chemical attribute, and permit quantitative remote sensing of the Earth, from space, for several terrestrial applications.
While information regarding spatial distribution of discontinuities can already be obtained by means of remote sensing techniques such as photogrammetry and LiDar, the mechanical characteristics of the material from which the rock is made cannot yet be assessed remotely. This study seeks to advance the ability to geotechnically characterize the rock by remote sensing, with emphasis on the mechanical properties of the intact rock material. Rock blocks of seven different carbonate rock formations belonging to Cenomanian and Turonian ages were collected from outcrops in southern Israel. The blocks were drilled and cylindrical rock samples 54 mm in diameter and 110 mm long were prepared. The cores were measured in the VNIR-SWIR region using the ASD FieldSpec Spectrometer. The reflectance was acquired from the round smooth cores and from the up and down surfaces. The uniaxial compressive strength of the rock samples was then determined and analyzed to depict a model to describe the strength of the samples solely from spectroscopy. Preliminary results from this pioneering study show that there is a relationship between rock strength and absorption levels at the wavelengths characteristic for carbonate minerals. Still, it is necessary to further deepen the database and the analytical method in order to establish a solid spectral based model to depict the rock strength using spectral measurements.