Automatic rock identification in macroscopic scale using image processing techniques: An application for planetary exploration

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Abstract

This work investigates digital image processing techniques for the automated identification of minerals in rock thin sections, i.e., in the microscopic scale. More specifically, algorithms have been developed that identify minerals and rocks in thin sections with the use of polarized light. A large number of thin sections of different types of rocks (plutonic, metamorphic, etc.) have been captured under the petrographic microscope in circularly polarized light conditions, in order to avoid mineral extinction. These images are taken under specific camera parameters (Correlated Color Temperature and Exposure Time), with defined luminance and stored in a database. Textural, albedo, and color features are extracted, including the average, standard deviation, roughness, skewness, contrast, etc. Furthermore, deep learning techniques (Neural Networks, SVM, KNN, etc.) have been developed and tested in order to choose the most efficient method. Following of the mineralogy identification, the rocks are then classified according to their type. These computer algorithms can be used in geosciences in order to detect micro-textural features such as the degree of crystallization. Our ultimate goal is to integrate such a system on a rover for autonomous exploration or even for the petrographic study of rocks when the in situ production of rock thin sections will be possible during space missions.

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