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An automatic methodology for analyzing sorting level of rock particles

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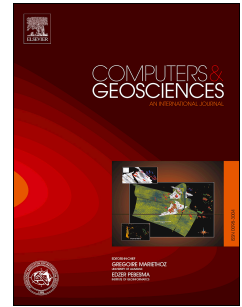
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1 An automatic methodology for analyzing sorting level of  
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12 **Abstract**

Previous efforts on analyzing the sorting level of rock particles rely on particle segmentation, which is time-consuming and inaccurate due to lighting and intra-particle statistical variations. With high-level features learned from a deep neural network, we directly conduct the classification of sorting in rocks. Our approach avoids the need for laborious segmentation and is entirely automatic. We use an off-the-shelf convolutional neural network (CNN) model that has been pre-trained on a large scale image dataset to extract feature representations for our rock images. Then we trained a support vector machine (SVM) classifier with the feature representations as input. The experiments show that the off-the-shelf CNN features lead to significantly improved results for the classification compared with handcrafted features and low-level K-means features.

13 *Key words:* off-the-shelf CNN features, sorting level, deep learning, SVM

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14 **1. Introduction**

15 The size, shape, and arrangement of crystals or grains in a rock consti-  
 16 tutes its texture and provides fundamental information regarding its origin.  
 17 Textures vary tremendously between igneous, metamorphic and sedimentary  
 18 rocks. In igneous and metamorphic rocks, textures can be related to cooling  
 19 rate, volatile content, history of deformation, etc. In sedimentary rocks, the

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Lei Shu labelled rock samples and conduct all the experiments.

Gordon R. Osinski provided rock samples and valuable suggestions on defining sorting levels and paper writing.

Kenneth McIsaac provided valuable suggestions on algorithms and paper writing.

Dong Wang helped refine algorithms and provided valuable suggestions of neural network.

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