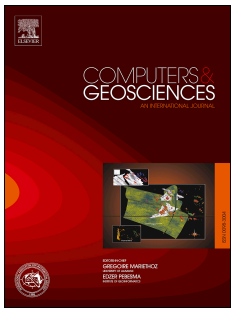
Accepted Manuscript



An automatic methodology for analyzing sorting level of rock particles

Lei Shu, Gordon R. Osinski, Kenneth McIsaac, Dong Wang

PII: S0098-3004(18)30051-7

DOI: 10.1016/j.cageo.2018.08.001

Reference: CAGEO 4164

To appear in: *Computers and Geosciences*

Received Date: 17 January 2018

Revised Date: 31 July 2018

Accepted Date: 3 August 2018

Please cite this article as: Shu, L., Osinski, G.R., McIsaac, K., Wang, D., An automatic methodology for analyzing sorting level of rock particles, *Computers and Geosciences* (2018), doi: 10.1016/j.cageo.2018.08.001.

An automatic methodology for analyzing sorting level of rock particles

Lei Shu[a,b,*], Gordon R. Osinski [b,c], Kenneth McIsaac [a,b], Dong Wang [d]

[a]*Department of Electrical and Computer Engineering, University of Western Ontario, 1151 Richmond St, London, ON, Canada N6A 5B7*
[b]*Centre for Planetary Science and Exploration, University of Western Ontario, 1151 Richmond St, London, ON, Canada N6A 5B7*
[c]*Department of Earth Science, Physics and Astronomy, University of Western Ontario, 1151 Richmond St, London, ON, Canada N6A 5B7*
[d]*Department of Computer Science, Harbin Institute of Technology, 92 Xidazhi St, Harbin, Heilongjiang, China 150001*

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.

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

1. Introduction

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

*Corresponding author
Email addresses: lshu2@uwo.ca (Lei Shu)

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.