

Extracting knowledge from microstructural images

ICME 2016

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ABSTRACT

Materials science is, at its core, the science and engineering of microstructure, and microstructural images are the foundational data of materials science. Computational techniques are widely applied both in the acquisition and analysis of microstructural images. When the catalog of possible microstructural features is known, such techniques can take advantage of well-defined feature characteristics to segment, analyze, and compare microstructures with high precision [1, 2]. However, when the features of interest are not known *a priori*, these methods may become intractable, inaccurate, or fail completely. In contrast, our goal is to develop a general method to find useful characteristics and relationships within and between micrographs without any assumptions about what features may be present. In this project, we develop and apply the ‘bag of visual features’ image representation, based on computer vision concepts, to create microstructural fingerprints that can be used to automatically find relationships in large and diverse microstructural image data sets [3]. For example, the bag of visual features can form the basis for a visual search engine that determines the best matches for a query image in a database of microstructures. Likewise, the microstructural fingerprint can be used to train a support vector machine (SVM) to classify microstructures into one of seven groups with high accuracy. Finally, the microstructural fingerprint can be correlated with quantitative microstructural metrics, thus providing image analysis without the need for segmentation or measurement.

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