Classification of Rock Images using Textural Analysis

Mr. Sachin K. Latad
Department of Electronics and Telecommunication Engineering
Prof. Ram Meghe Institute of Technology & Research
Badnera, Amravati, Maharashtra, India
sklatad@gmail.com

Prof.(Dr) S. M. Deshmukh
Department of Electronics and Telecommunication Engineering,
Prof. Ram Meghe Institute of Technology & Research
Badnera, Amravati, Maharashtra, India
hod_extc@mitra.ac.in

Abstract- The classification of natural images is an useful task in current computer vision, pattern recognition applications etc. Rock images are a typical example of natural images, therefore their analysis is of major importance in the rock industry and in bedrock investigations. Rock image classification is based on specific textural descriptors which are extracted from the images. Using these descriptors, images are divided into various types.

In the case of natural images, the feature distributions are often non-homogeneous and the image classes are also overlapping in the feature space. This can be problematic, if all the descriptors are combined into a single feature vector in the classification of an image. A method is presented for combining different visual descriptors in rock image classification. In this paper, k-nearest neighbor classification will be carried out for pair of descriptor separately. After that, the final decision is made by combining the results of each classification. The total numbers of the neighbors representing each class are used as votes in the final classification. The classification method will be tested using three types of rock.

Keywords – *Feature extraction, Textural descriptors, K-Nearest neighbourer*

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I. INTRODUCTION

In the field of rock research, the development of digital imaging has made possible to analyze and classify the rock samples in digital form. In rock and stone industry one basic problem is classification of the rock samples. It is essential for the manufacturer to be able to classify the rock samples in visually similar classes. For example, stone plates in walls of buildings are often required to appear visually similar. This classification conventionally carried out manually based on experience. However, in digital form, the rock samples can be analyzed and classified in automatic way.

The division of natural images such as rock, stone, clouds, ice or vegetation into classes based on their visual similarity is a common task in many machine vision and image analysis solutions [1]. Classification of natural images is demanding, because in the nature the objects are seldom homogenous. For example, when the images of rock surface are inspected, there are often strong differences in directionality, granularity or colour of the rock, even if the images represented the same rock type. In addition to non-homogeneities, the feature patterns can also be noisy and overlapping, which may cause variations in the decision surfaces of different classifiers.

In the field of pattern recognition, different texture types are commonly studied topics. Texture is an important characteristic of many image types, and it can be used for example in image segmentation. Textures can be divided into two categories: deterministic and stochastic textures [1]. The deterministic textures consist of repetitive similar patterns, whereas the stochastic ones obey only some statistical laws. Most of the real world textures, like grass or ice, are stochastic. An example of natural textures is rock texture. Analysis of rock texture is quite demanding. Also granular size and colour of the texture may vary significantly in some rock texture types. Due to these properties, analysis and classification of rock textures is a difficult task. The motivation of the work done in the project is related to control of quality and production of rock samples.

II. PROBLEM DEFINATION

The classification of natural images is an essential task in current computer vision and pattern recognition applications. Rock images are a typical example of natural images, and their analysis is of major importance in the rock industry and in bedrock investigations. Natural rock images are example of non-homogeneous textures which are random in natures. There are three types of rocks i.e. igneous, metamorphic and sedimentary. In marble industry requires metamorphic type of rock.

In marble industry, the specialized person is required to select the desired type of rock. In order to decrease human resources or human error due to false identification of rock, classification method is proposed in which classification of rock is based on textural analysis of rock images.

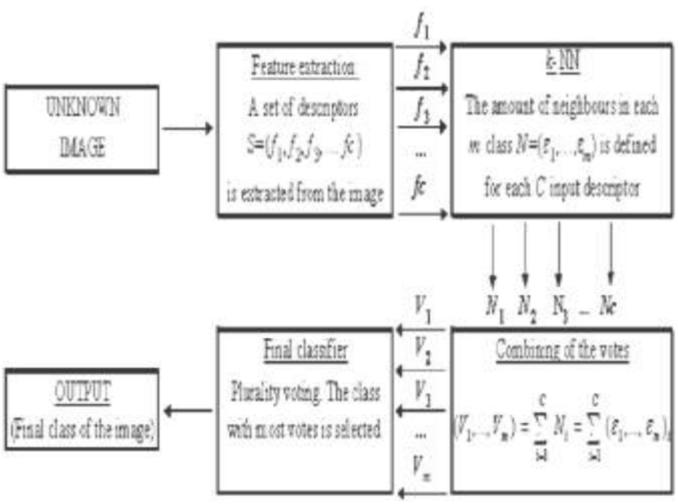
III. Proposed Algorithm

First step was the textural feature extraction from rock images. The classifying features were based on the co-occurrence matrix.

Commonly used classifying features of texture are measures, calculated from the gray level co-occurrence matrix.

Some of the non-homogenous textural features are used to distinguish between the rock textures.

For the purpose of classification based on different features, K-NN classifier is used.



Different visual descriptors (feature sets) obtained from non-homogenous images can be easily and effectively combined using classifier combinations employing k-nearest neighbour (k-NN) classifiers [1][2]. This is because the k-NN principle is robust to the variations and non-homogeneities in the dataset. Furthermore, the k-NN method is simple and fast and it is easy to implement. It has also suitable for feature spaces with overlapping classes. Furthermore, the employment of k-NN base classifiers in classifier combinations is motivated, when separate feature sets are employed. Because by selecting appropriate feature sets for the base classification, diverse and accurate base classification can be achieved.

In voting-based techniques, the final decision is made based on the outputs of the base classifiers by voting. Hence, voting-based methods do not require any further training in the final classification, as most other combination methods. This makes them simple and computationally effective methods. In addition, the risk of overtraining can be avoided. Voting has found to be an accurate and effective method for combining classifiers in several classification problems. Voting-based methods can be divided into two classes, majority voting and plurality voting. Majority voting requires the agreement of more than half of the participants to make a decision. If majority decision cannot be reached, the sample is rejected. In contrast, plurality voting selects the sample that has received the highest number of votes. The plurality voting is more efficient of these two techniques. Furthermore, using plurality voting, the problem rising with the rejected samples can be avoided because all the samples can be classified [2].

Different visual descriptors are extracted from the images as inputs for the base classifiers. Thus the descriptors are not divided into one-dimensional features. Instead of that, use the n-dimensional visual descriptors as themselves as inputs of the base classifiers. In this approach, the method of combining plurality voting with the k-NN classification principle, which in fact is also based on voting, is used. This is because, in the k-NN principle, the class of unknown sample is decided on the basis of the most frequent class within the k-NN samples of the sample in the feature space. In this approach, the votes of each k-NN base classifier are used to make the final voting. This kind of approach is able to improve the accuracy of ‘uncertain’ k-NN base classifiers. For example, assume that a 5-NN classifier has to decide the class label of an unknown sample that is located at the decision boundary of classes A and B in the feature space. If two neighbours vote for class A and three neighbours vote for class B, then the 5-NN classifier decides that the class label of the sample is B.

IV. REFERENCE

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