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Design and Implementation of A MATLAB GUI-based Rock Fracture Processing System

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Abstract

MATLAB, as a powerful interactive tool for algorithm development and visual analysis, integrates a toolbox with a variety of algorithms and is widely used in digital image processing with powerful data processing capabilities. Based on MATLAB image user interface (GUI) and image processing toolbox, this paper designs and implements a processing and analysis system for rock fractures by combining theoretical techniques and mathematical modelling methods related to digital image processing. The system can implement rock image fracture recognition, image operation, transformation, filtering, segmentation, edge detection, morphological processing and other content. The system functionality is verified and usability evaluated by means of example analysis. The example analysis shows that the system is convenient, practical and interactive, and provides an intuitive and convenient processing system for the identification and processing of rock fractures.

Keywords

Rock fissures; MATLAB GUI; Image recognition; Image processing.

1. INTRODUCTION

The stability of rock masses is closely related to the development of internal fractures, which are the root cause of rock damage. The project uses close-up photogrammetry to obtain rock fracture data, combines theoretical techniques related to digital image processing and mathematical modelling methods, and relies on the MATLAB platform to design and develop an analysis system for rock fractures. It mainly includes the processing of fracture images, fracture extraction and the calculation and analysis of shape parameters such as length, width and area, providing a new means to study the expansion pattern of fractures and providing auxiliary decision-making for the construction safety of rock projects.

2. MATLAB GUI AND DESIGN INTRODUCTION OF SYSTEM

MATLAB is a collection containing a large number of calculation algorithms, efficient numerical and symbolic calculation functions, which can free the user from the complicated analysis of mathematical operations, complete graphics processing functions to achieve the visualization of calculation results and programming, feature-rich application toolbox, providing users with a large number of convenient and practical processing tools, in-depth into scientific research and engineering calculations, image processing and other fields.

MATLAB GUI, known as Graphical User Interface or GUI for short, is an interactive user interface displayed in graphical style, providing users with a variety of graphical controls such as Button, Static Text, Listbox, etc. By setting the position, appearance and properties of the controls, and writing callback functions to adjust the functions of the controls to achieve user requirements and provide convenient and simple operation functions.

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The processing and analysis system of rock fissures designed in this paper covers the relevant functions provided by MATLAB, combined with photogrammetry technology, graphic image processing technology, mining technology, through the cross-fertilisation of multiple disciplines, image processing and fissure parameters calculation and other related algorithms. It supports image file formats such as PNG, JPEG, GIF, etc. It supports the recognition of rock image fissures, image operations, transformation, filtering, segmentation, edge detection, morphological processing and other functions to realise the processing and analysis about rock fissure images.

3. THE OVERALL DESIGN OF THE IMAGE PROCESSING SYSTEM

The system design integrates six modules: image acquisition, image transformation, image segmentation, image enhancement, image filtering and edge detection, containing various image processing algorithms and designing corresponding image export functions. By changing the parameters of the controls and writing corresponding callback functions, the processing and analysis functions of rock images can be realised.

4. THE INTERFACE AND FUNCTION OF SYSTEM

4.1. The design of the system interface

The main interface of the rock fracture processing and analysis system consists of image display, fracture parameters, oscilloscope, display adjustment, morphological operations, image enhancement, filter processing, noise processing, base transformation, edge detection and contains four controls: button, panel, progress bar and text box, each button sets the corresponding callback function for image processing.

4.2. Gray-scale linear transformation

A greys-cale linear transform is a greyscale transformation that adjusts the greyscale of a source image by creating a greyscale mapping for the purpose of image enhancement. A greys-cale linear transform is a transformation of the pixel values of an image by means of a specified linear function to enhance or diminish the greyscale of the image. The results of grayscale linear transformation analysis are shown in Figure 1 and Figure 2.

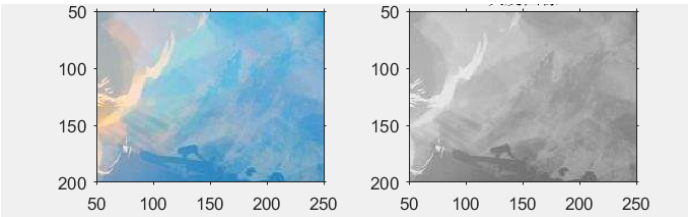

Figure 1. The results of grayscale linear transformation analysis

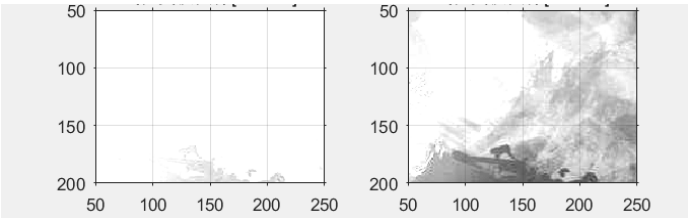

Figure 2. The results of grayscale linear transformation analysis

4.3. Wavelet transform

The wavelet transform is a new transform analysis method which inherits and develops the idea of localisation of the short-time Fourier transform, but at the same time overcomes the

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disadvantages of the window size not varying with frequency. The results of wavelet transform are shown in Figure 3.

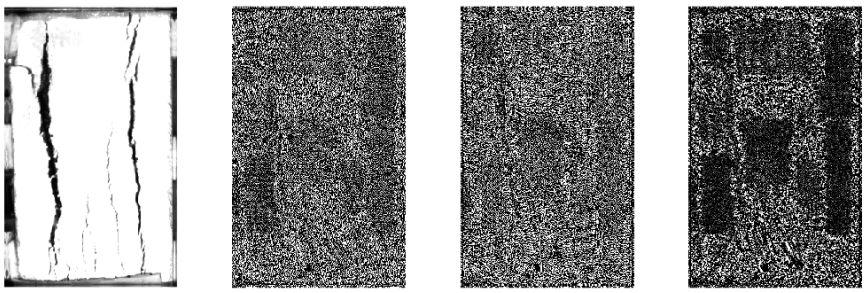

Figure 3. The results of wavelet transform

4.4. Grayscale transformation

The process of converting a colour image into a greyscale image is the process of greyscaling the image. Image greyscaling simplifies the matrix and increases the speed of operations. Many image processes require an advanced greyscale transformation, which is the basis for doing other image processing operations. Before and after greyscale transformation comparison diagrams are shown in Figure 4 and Figure 5.

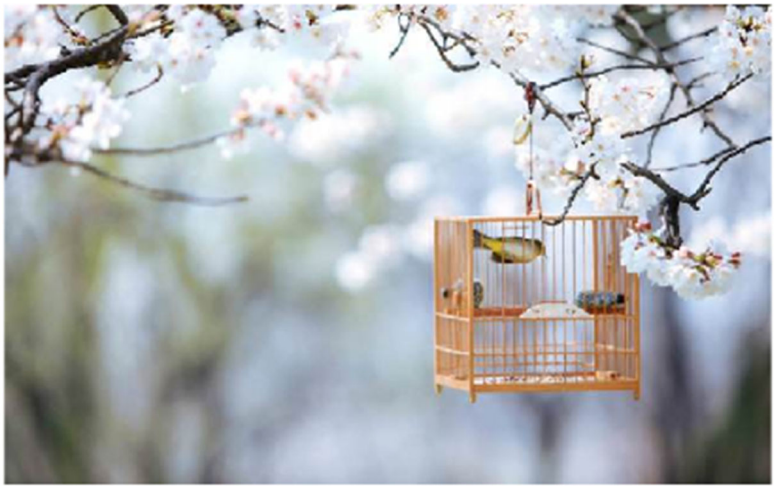

Figure 4. Original image

Figure 5. The results of the grey scale transformation

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4.5. Binarization

The purpose of image binarisation is to facilitate the extraction of information from an image. Binarised images can increase the efficiency of recognition when carrying out computer recognition. For example, if you need to calculate the amount of suspended material on the water surface, you can take a picture of a certain area of water and binarise it. A binary image is an image in which each pixel is either black or white, with no intermediate transition between the grey values. Binary images are generally used to depict text or graphics and have the advantage of taking up less space. A comparison of the image before and after binarisation is shown in Figure 6.

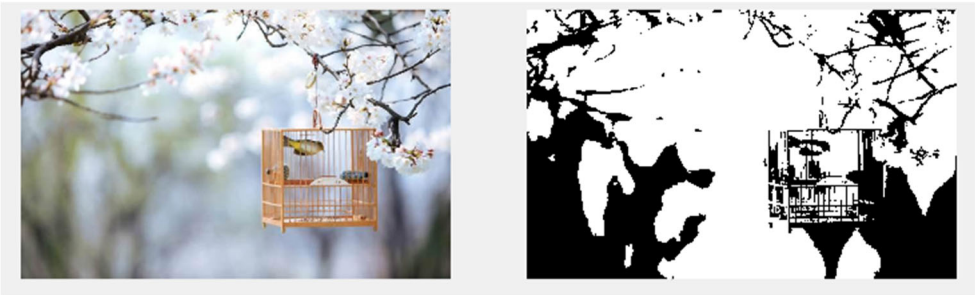

Figure 6. The results of image binarisation process

5. CONCLUSION

This paper utilises the powerful numerical calculation, data analysis and image processing capabilities of MATLAB to design and implement a rock fracture processing and analysis system based on a GUI graphical user interface. The system enables the identification of fractures in rock images, image computation, transformation, filtering, segmentation, edge detection and morphological processing. The system functionality is verified and usability evaluated through example analysis. The example analysis shows that the system is convenient, practical and interactive, and provides an intuitive and convenient processing system for the identification and processing of rock fractures.

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