

# The Design of the Geological Image Automatic Identification System

Du Cheng

College of Electric and Information  
Engineering, Southwest University for Nationalities  
Chengdu, China

Leng Biao

School of Civil Engineering, Southwest Jiaotong  
University, Chengdu, China

**Abstract**—With the development of highway in our country, geological structure of the artificial analysis method, will waste a lot of time, manpower, financial and material resources. Although the digital image processing is applied to the analysis of geological structure in the initial stage, but can greatly reduce the project cost, speed up the progress of the project, it will gradually replace the manual analysis of geological structure, become the development direction of the future. Geological image processing and analysis of the geological structure will be more and more widely, the higher the geological image handler function, using the computer automatic identification modeling simulation, full access to secure data construction, it is much easier to, this paper introduces in detail the geological image recognition system model is built and the geological image recognition system design of the main modules are analyzed, through the automatic identification system can check the geology situation, can also according to the system model is deduced in tunnel geological conditions

**Keywords**—3D reconstruction; Analysis of feasibility; geological image

## I. THE SYSTEM FEASIBILITY ANALYSIS

Image recognition and reconstruction system is designed in the understanding to the actual geological situation under the condition of technical requirements, in based on application, emphasis on practical and technology under the guidance of give attention to two or morethings, both on the surface of the height, and a little further, it is feasible. This system from the overall framework design, to the classification module design, and many of the application system planning are using the technology and method, such as object-oriented OOP technology, vc++ development technology, OpenGL technology, etc. Every kind of techniques and methods is advanced or more advanced, though Japan has done some research in this field, however, at present no matter domestic or foreign, in this respect has not corresponding mature practical cases for reference, only in other aspects such as medical and military applications, therefore, we believe that through the relevant technology to develop this system, now is feasible, and has certain innovative. Demand for system design and development, the need to conduct site collection of geological data, therefore, the progress of the project, mainly adopts the following method and way to obtain:

(1) with the progress of the project construction, the geological section of every excavation cycle with a digital camera to collect images, and in the cross section of the

manual record the strata, fault, joint and fissure, location, and so on and so forth. For the following Continue processing data to provide the reference data.

(2) collect geological design, the construction of the information and advance geological forecast and water inflow forecast field first-hand.

To sum up, this project is feasible.

## II. THE SYSTEM STRUCTURE

The structure of the image processing system as shown in the figure below

The function of each subsystem are as follows:

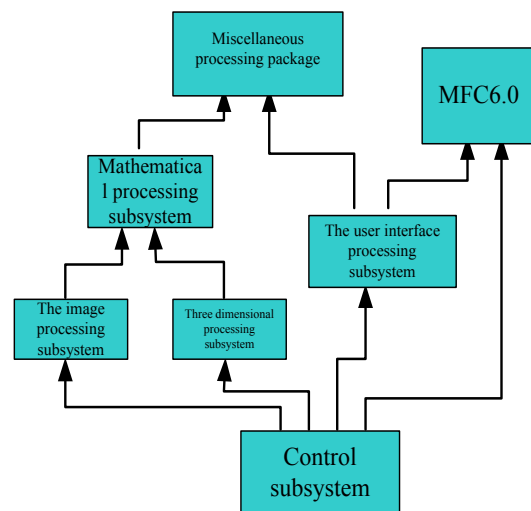


Figure 1. system package refining structure

1) the MFC6.0 Is Visual Studio 6.0 comes with a framework of package design, is the core of the system function and standard interface design module.

2) miscellaneous processing subsystem: mainly to complete the definition of a generic data structure, especially the other subsystems of Shared data classes, data structures, such as common functions are realized in this package.

3) mathematical processing subsystem: complete many conventional mathematical processing, including general matrix processing, mathematical morphology, the target characteristic parameter calculation, image coding, etc. Matrix processing including matrix, matrix between the add, subtract, left, set the matrix element, the gain matrix,

width, height, etc. Mathematical morphology including corrosion, expansion of the matrix, opening operation and closing operation, refinement, medial axis transform, etc. Target characteristic parameter calculation including the moment calculation, long and short axis of the target, the target area gray and gray levels, grayscale average, maximum and minimum gray value. Image coding is mainly refers to the target run-length coding of all kinds of processing.

4) image processing subsystem: all of the image processing functions are realized in this package, especially the color images, gray image, binary image processing. Including the color space transformation, color clustering, all kinds of high pass and low pass filter, image transformation, the boundary chain code, mathematical morphology, etc.

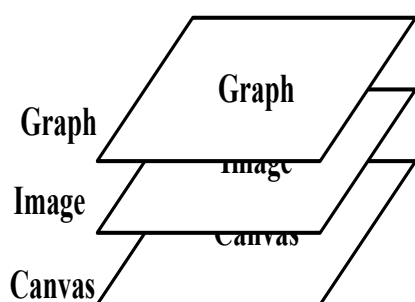


Figure 2. layer logical structure

5) 3 d processing subsystem: based on OpenGL 3 d processing, complete 3 d object modeling and control.

6) the user interface subsystem: complete the extensions of the standard Windows controls and custom design conforms to the characteristic of this system interface elements.

7) control subsystem: namely "geological image processing system" of the main program, all the packages in the control system under the coordination of other needed to complete the system functions correctly.

As the definition in the TilCore are common composition of other parts. Therefore, other each packet must contain TilCore package. MathProc in with the image processing and 3 d graphics processing the necessary processing, so as the core of Ipl and Ipl3D system must contain MathProc can complete their functions.

GuiExt just to complete the processing interface elements and space, is not involved in the function of the specific processing, therefore, only GuiExt contained 6.0 MFC package can be.

As control subsystem, TilSys of each package in the right combination of other cases, the synergy between each package must be completed, as a result, TilSys must include all the correct information of each package.

the layer logical structure design points

Layer in the concept has been used in many image processing software, such as Photoshop, AutoCAD, etc. The design process of this system also fully absorb the concept and the concrete design.

Layer distribution is shown in Fig .2, Canvas layer is located in the bottom, the Image layer located at the middle tier, Graph layer located at the top. Among them, have the effect of a Canvas, Canvas layer in any graphics must prevent the Canvas to display properly. Image to Image layer, the layer of data or for the actual Image data. Graph layer is used for data processing features, such as segmentation result, often for binary graphics operations, the results of these operations shall not affect the original image data, tightly on the characteristics of graphics.

Fig .3 for an application example. Original Image is the Image of the original Image (middle) there are some characteristics in the data Graph (on the left side of the characteristics of Image), after superposition of the two images were displayed as Canvas (figure to the right of the overlay).

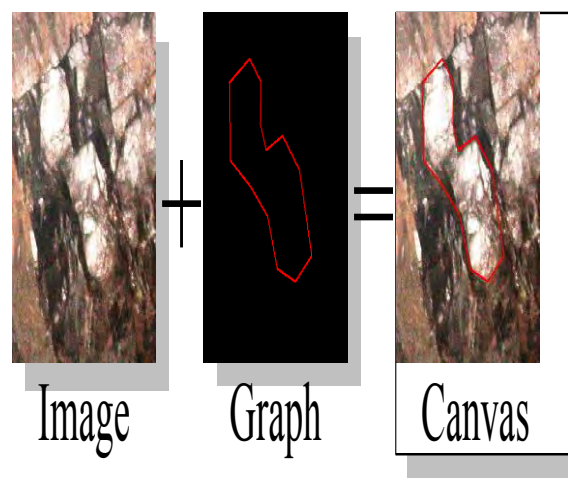


Figure 3. layer using the instance

### III. ARTIFICIAL PROCESSING

Tunnel constraints image is very complex, different constraints image need to adopt different algorithms for processing according to specific situation. Especially in the image segmentation, extraction of target edge, artificial intervention is important. Without human intervention, once the problems with the goal of image edge extraction, image segmentation error, subsequent processing image pattern recognition, such as 3 d reconstruction will be badly affected. A lot of time with image processing algorithms can't achieve the result of hope, at this moment need for human intervention, the image processing results are certain correction, to expect the results of hope.

In the image processing system, manual intervention is mainly used in image segmentation and pattern recognition. Constraints on tunnel image image segmentation, each target are extracted from the edge of the rock, in the image tag on the graphics layer. If some edge tags and have larger in and out of their expected, is the edge correction is made on the graphics layer. To remove some unnecessary edges in automatic edge marker, this part will refer to the edge of the image to draw in manual mode.

Pattern recognition is sometimes the need for human intervention. Targets in the images of the constraints that each rock tunnel. After segmentation to extract various

strata, need to make sure that these belong to what kind of rock strata division. Need to analyze the strata within the image information at this time, to extract the characteristic data of strata, to judge the rock properties, and so on information. Constraints due to the complexity and particularity of image, the rock there are a lot of internal image often appear all sorts of special cases. Have A slight crack, such as rock internal appear artificial the chisel marks, etc., make the rock image to extract the characteristics of data appear many accidents, without human intervention, may make should be judged to be A final judgement for class B class strata.

In order to know the geological tectonic situation, it is necessary to simulate the geological 3d reconstruction, through the reconstruction of 3d geological model from different perspective of geology.3d reconstruction using OpenGL 3 d modeling technology. The Open is the full name of OpenGL Graphics Libaray, is a 3 d Graphics and model library. It is a new generation of 3 d graphics industry standard. OpenGL is not only a graphics library, it is an Application program Interface (Application Programming Interface).

Need to pay attention to in the process of 3d reconstruction is how to build the adjacent geological image block boundary, the relation between the same strata only correspondence set up correctly, to restore the accurate three-dimensional models. In the system by pattern recognition algorithm will be that of the strata boundary constraints of adjacent images, eventually establish the constraints in image sequence strata corresponding relation. At the same time, considering the situation, there may be predicted using the algorithm of pattern recognition especially rock fault occurred, make the rock that should be associated with no connection, but should not be associated with rock. Way, therefore, need to use manual intervention to the actual rock target in the adjacent images corresponding relation changes are relatively.

#### IV. INTERFACE DESIGN

Digital camera close shot photogrammetry subsystem in this system are implemented by hardware, the front have been introduced, the system of image processing and 3 d reconstruction subsystem are implemented by software, the software research and development is based on Visual c++ development platform, set up the Windows standard Windows interface, system startup interface as shown in Fig .5 to 11, Fig .5-12 constraints is automatic image recognition subsystem interface.

(1),Documents: including new project, open the project, close the project, save the project, project save as, add the image file and print, print preview and print Settings, and so on, add image file, if the current project already exists, in the image files will be added to the current project, if the project does not exist, in the add image file stylish build a project, add the image file to the new project.

(2) image processing, including image preprocessing, image segmentation and feature extraction. Provides the functions of image preprocessing are: gray level

transformation, histogram equalization and histogram specification, single mapping rules, set of mapping rules, texture, edge detection, high-pass filter, low-pass filtering, color clustering, contrast extension and region growing, iterative threshold, Susan operator, Canny operator, gray bandpass transformation, gray band stop transformation, gray level window transformation, gray line transformation, dynamic threshold segmentation. Of the function of image segmentation are binary corrosion, expansion, binary arithmetic, binary closed operation, binary refinement, binary coarsening, axial transformation, edge detection, edge extraction, threshold segmentation and target area. Feature extraction, the characteristics are: the actual area, center coordinates, the external rectangular, gray and gray levels, grayscale average, maximum, minimum grey value, invariant moment and so on.

(3) target editor: the result of image processing is to extract the strata boundary information, and to extract the rock formation, the characteristics of the target constraints due to the image, the image quality is good and bad, the image processing results not just rock to extract the image boundary, therefore, the target editing function, manual correction of target boundary.

(4) pattern recognition: pattern recognition is included on the constraints of adjacent rock target corresponding relation of pattern recognition, and the constraints on the strata rock category of target recognition. At the same time, the target corresponding relation of error on the constraints of adjacent strata, and the rock target misjudgment, provides the function of human intervention.

(5) the 3 d reconstruction, 3 d reconstruction provides for the 3 d modeling functions of the tunnel, at the same time also includes the view of 3 d tunnel of left or right view, top view, front view, arbitrary Angle rotation, etc. In addition, also including the tunnel light adjustment, bedding, bedding selection and display, cutting, and other functions.

#### V.PROCESS INSPECTION

(1) the image input and maintain the image attributes

First enter the tunnel close shot photogrammetry system in a different location filming constraints of tunnel images, all images file input image processing system, the image list displayed in the system of working table window. When shooting at the same time the input of each image within the azimuth Angle and azimuth parameters such as outside. Can modify the parameters of the constraints of each image, adjust the order of the constraints, etc.

(2) image preprocessing

The input system of each image, to a certain image preprocessing, image constraints make it more in line with the human eye observation, so more conducive to system operators to in-depth analysis of constraints of image.

Constraints due to use of digital camera to obtain images using wide Angle lens, there is a barrel distortion, need for image distortion correction, Fig .4 and Fig .5 is the original image and the constraints resulting from the original image distortion correction of images.

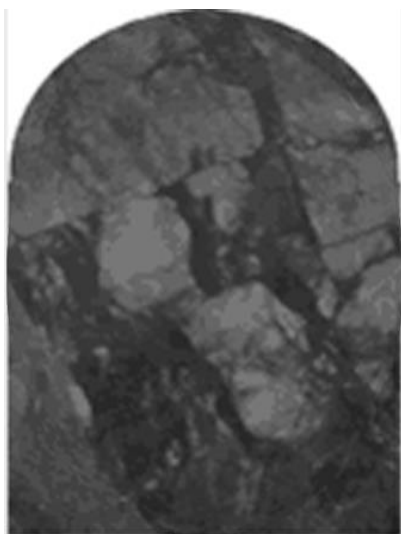


Figure4. tunnel constraints original image

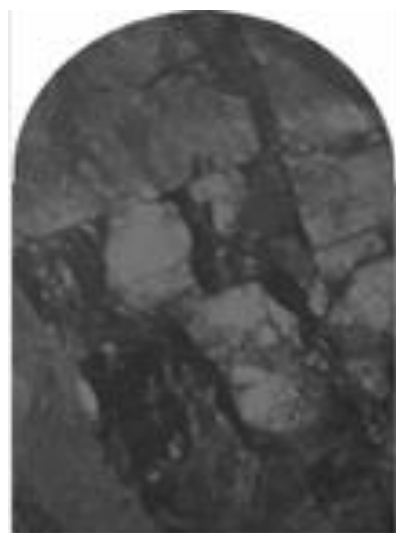


Figure 5. the original image correction result

Fig .6 is the preprocessing results of Fig .4. Constraints are usually taken in tunnel due to the work environment, is usually gloomy, as shown in Fig .4. Fig .6, is obtained by image preprocessing, can be seen from Fig. 6, image brightness and contrast are enhanced, so want to take the next step to deal with more convenient also.

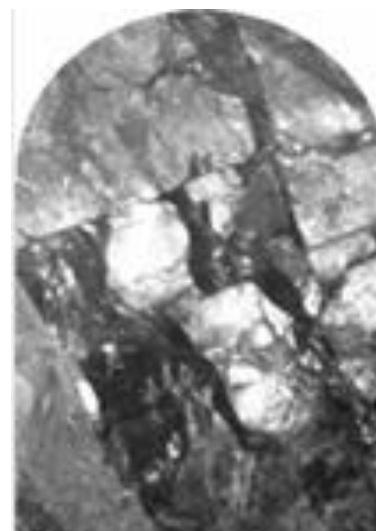


Figure 6. image preprocessing results

For preprocessing the image after finishing, considering there are two kinds of processing mode, one is using the edge detection of image edge detection operator, rock boundary information extraction according to the test results; Another method is to directly target strata division, according to the division of rock block boundary extraction.

## VI. THE CONCLUSION AND PROSPECT

This project mainly is the study of the geological image of graphics and image processing and OpenGL 3 d reconstruction. Through the analysis of geological image, automatic supplemented, manual ways to extract the rock cracks and boundary of the target, for follow-up of 3 d modeling of the tunnel to provide the necessary reference information. It on the analysis of the geological image can be liberated from the artificial repetitive work, and can avoid some artificial analysis error, so that to guarantee the quality of the constraints on the image analysis at the same time also greatly improve the efficiency of the analysis, plays an very important role in the tunnel construction.

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