Development of Rock Slope Survey and Analysis System using GIS

H. J. Park
Department of Geoinformation Engineering, Sejong University,
98, Gunja-dong, Gwangjin-gu, Seoul 143-747 South Korea
hjpark@sejong.ac.kr

B. S Chang
R & D Division, Korea Infrastructure and Technology Corporation
2311 Taehwa-dong Ilsan-gu, Koyang-si, Kyunggi-do
orpheous@kistec.or.kr

S. Lee
Geoscience Information Center, Korea Institute of Geology & Mineral Resources (KIGAM)
30, Gajung-dong, Yusung-gu, Daejeon, 305-350, Korea
leesaro@kigam.re.kr

Abstract: Techniques for rock slope management and assessment must be developed for the prevention and mitigation of rock fall hazards. To enable this, the rock discontinuity such as fault and joint data must be surveyed, analysed and managed. For this, the discontinuities were detected by automatic and semi-automatic method using DEM and ortho-rectified image of rock slope and the rock slope analysis and management system was developed using GIS. Using the system, slope locations and discontinuities data were constructed to spatial database. The system is consist of 'Data Management', 'Rock Slope DB', 'Basic Information', 'Image Processing', 'Image Analysing', 'Edit', 'View', 'Theme', 'Graphic', 'Window' and 'Help'. The system was developed using avenue of ArcView 3.2.

Keywords: Rock slope, GIS, Discontinuity, Digital Photogrammetry

1. Introduction

The aim of this study is development of discontinuity analysis and management system for stability analysis of rock slope using GIS and digital photogrammetry techniques. For this, discontinuity survey and analysis system for rock slopes using GIS was developed. The system consists of two types of module. The one is acquisition of rock slope, processing image, extraction of discontinuity and the other is field survey of rock slope and input of the rock slope data. The two modules integrated to Integrated Survey and Analysis System(DRASA) for rock slope analysis using GIS such as Fig. 1. The system can extract 3D geometric information of discontinuous data using DEM and ortho-rectified image. Also, the system can detect the discontinuous data automatically and semi-automatically using the DEM and orthophotograph.

The integrated system was developed using graphic user interface (GUI) and desktop GIS program, ArcView 3.2. The system is consist of 'Data Management', 'Rock Slope DB', 'Basic Information', 'Image Processing', 'Image Analyzing', 'Edit', 'View', 'Theme', 'Graphic', 'Window' and 'Help'. The system was developed using avenue of ArcView 3.2.

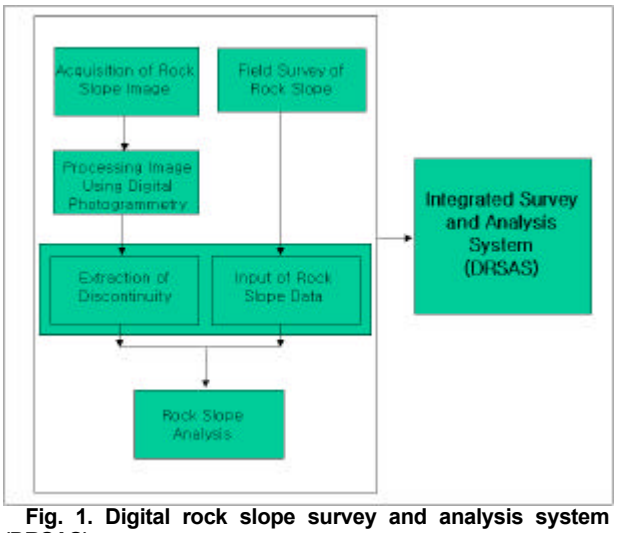

Fig. 1. Digital rock slope survey and analysis system (DRSAS)

2. System Function

The system was developed for manage and analysis of rock slope and its related data. In the 'Rock Slope DB' menu, the information for slope and related data can be inputted and constructed to spatial DB. So the DB can be retrieved and managed. In the 'Basic Information' menu, the topographic and geological map can be retrieved. In the 'Image Processing' menu, DEM and ortho-photogrammetry image can be created using digital photogrammetry images and images can be mosaicked. For digital photogrammetry processing, the commercial software "SIROJOINT" was used. In the 'Image Analyzing' menu, the discontinuous data can be detected automatically and semi-automatically and can measure 3-densional dip and dip direction of the discontinues data

using DEM and ortho-photogrammetry. Also the Dip/Dip direction, area, continuity were calculated and constructed to spatial DB for each plane.

3. Application of the System

Using the system, rock slope and discontinuity were processed and detected. Then the dip and dip direction of the discontinuity and rock slope surface were analysed. The image of rock slope is shown in Fig. 2 and 3D image is shown in Fig. 3. The 3D image was created using DEM. Then using the image of rock slope, discontinuous plan was detected using automatically linear extraction techniques such as Fig. 4. The final discontinuous plan in shown in Fig. 5 with modification of Fig. 4. Using the DEM of the rock slope the dip and dip direction was calculated such as Fig. 6 and Fig 7.

4. Conclusion and Discussion

Techniques for rock slope management and assessment must be developed for the prevention and mitigation of rock fall hazards. To enable this, the rock discontinuity such as fault and joint data must be surveyed, analyzed and managed. For this, the discontinuities were detected by automatic and semi-automatic method using DEM and ortho-rectified image of rock slope and the rock slope analysis and management system was developed using GIS. Using the system, the rock slope survey can be objective and the survey and management time and cost can be decreased. Also, the safe survey can be possible for inaccessible rock slope. Moreover, the systematic management and visualization can be possible using spatial DB and 3D visualization. So, the objective and scientific data can be provided.

Fig. 2 Image of rock slope

Fig. 3. 3D image of rock slope

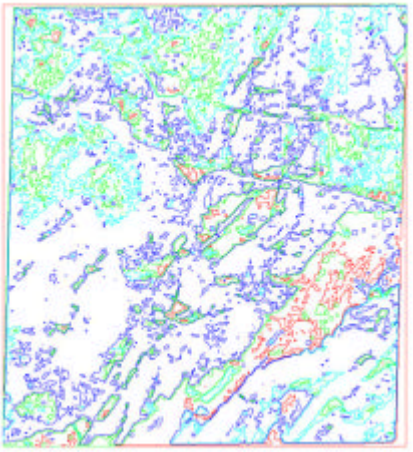

Fig. 4. Discontinuous plan using automatic linear extraction

Fig. 5. Discontinuous plan of rock slope using automatic and manual linear extraction..

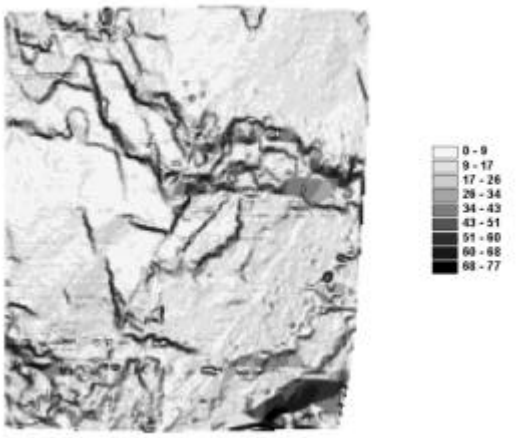

Fig. 6 Distribution of Dip

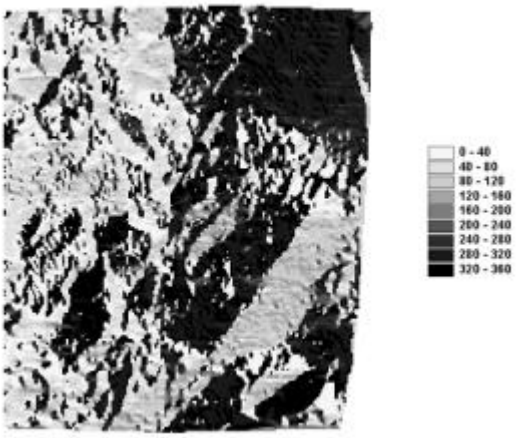

Fig. 7 Distribution of Dip Direction