WORKSHOPS ARE OFFERED IN CONJUNCTION WITH THE EVENT

ROCK ENGINEERING IN DIFFICULT CONDITIONS

"3rd Canada-US Rock Mechanics Symposium" & "20th Canadian Rock Mechanics Symposium"

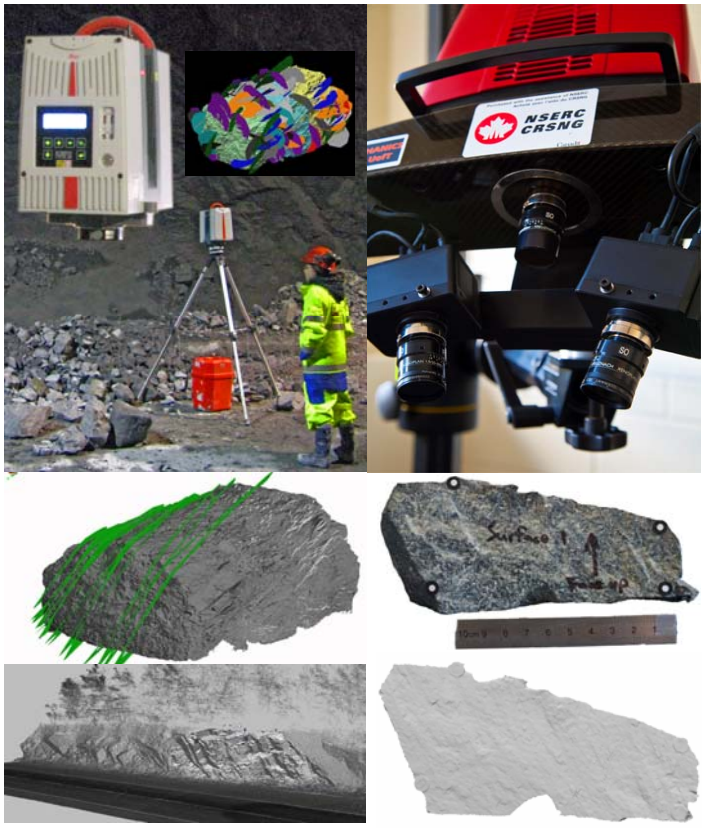
A Joint Meeting of the Canadian Rock Mechanics Association & the American Rock Mechanics Association
in Conjunction with the 2009 CIM Annual Conference and Exhibition

Lidar, photogrammetry and remote sensing technologies in Rock Engineering

Giovanni Grasselli & Bryan Tatone *University of Toronto*
Mark Diederichs, Stephanie Fekete & Mathew Lato *Queen's University*

May 14, 2009
Toronto ON, Canada

WORKSHOP FEE: $400
MINIMUM 6 PARTICIPANTS



OBJECTIVES

There are a number of different systems currently available on the market that can provide engineers and geologists with accurate 3-dimensional reconstruction of fractures, slopes, or excavated surfaces in rock. These systems and the associated processing techniques can provide a great deal of data for rock engineering.

With this course we will explain how it is possible to extract useful "numbers" out of 3-dimensional rock-mass reconstructions that can be directly used for engineering computations. Properties of fracture systems (orientations, spacing, persistence, seepage) can be remotely determined using these technologies. Rockfall source zones can be identified through time-series imaging, overbreak information in tunneling can be analyzed and failures reconstructed. In a detailed study, determination of the global mechanical properties of a jointed rockmass is possible. In particular, fracture roughness has a major influence on the frictional behavior of discontinuities under shear loads, including the creation of damage zones, and needs to be carefully considered when estimating the strength of rock masses. Precise digitalization of joint surfaces can help us to quantitatively estimate their 3D roughness value and integrate it into a criterion for shear strength of rock joints to be used in numerical codes.

LEARNING OUTCOME

The participants of the course will learn:

1. What are the measurement system available for measuring fractures, slopes, or excavated surfaces in rock (i.e., digital photogrammetry, laser and optical scanners)
2. What are the methodologies that can be uses for extracting engineering parameters including joint orientation, seepage, joint spacing and rockmass quality from 3-D digital reconstructions.
3. What processing resources and techniques are required for practical application of this technology in a working rock engineering environment, including surface and underground works.
4. How to characterize the joint roughness both in the lab and in-situ and to calculate roughness parameters
5. how to use of roughness parameters to estimate the shear strength of rock joints and rockmasses.

WHO SHOULD ATTEND:

The course is intended for engineers, geoscientists, technologists, and students involved in digital rockmass characterization with specific emphasis on rock joints and jointed rock mass. For those with a geomechanics (rock and soil mechanics) background, the

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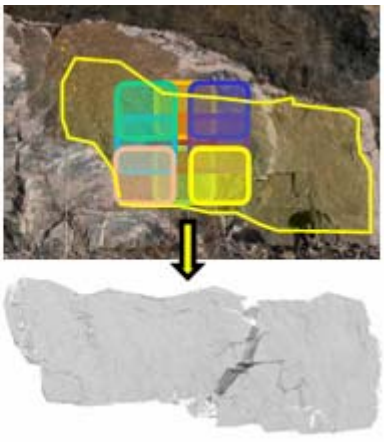
course will serve as an introduction to typical geoengineering issues arising when dealing with fractured rock masses. The basic aspects due to the presence of rock fractures and spatial variability of joint shear strength related to roughness and microstructural characteristics of the rock will be presented in a simple, clear manner, without complex equations. Examples from laboratory and in-situ tests will be used to illustrate the topics. The 1-day course will provide each participant with (i) the opportunity of testing a variety of 3D scanners, (ii) and an understanding of how to extract valuable data from digital models of rock masses and rock joints, which can be directly used into numerical models. A great deal of material will be provided to each participant as notes and electronic media, far more that can be covered in one day. Each participant will be given a CD containing all the PowerPoint presentations and additional material covering a wide range of topics, including research software to be used for the estimation of surface roughness parameters.

TIME SCHEDULE:

8:30—10:15	Lectures/demonstrations
10:15—10:30	Coffee break
10:30—12:15	Lectures/demonstrations
12:15—13:15	Lunch
13:15—15:00	Lectures/demonstrations
15:00—15:15	Coffee break
15:15—17:00	Lectures/demonstrations



Queen's Geomechanics Group

GEOMECHANICS GROUP @ UofT

UNIVERSITY OF TORONTO LASSONDE INSTITUTE

BIOGRAPHY of Prof. Grasselli:

Dr. Giovanni Grasselli is a professor of Civil Engineering at the University of Toronto, Canada, and is Associate Director of the Lassonde Inst. for Eng. Geoscience. Dr. Grasselli holds an BSc in Civil Engineering (1995) from the University of Parma, Italy, and a PhD in Rock Mechanics (2001) from EPFL, Lausanne, Switzerland. His thesis ''Shear Strength of Rock Joints based on Quantified Surface Description'' was awarded with the 2004 ISRM Rocha Medal. He has been a research associate at Imperial College London (UK), Sandia National Labs (USA) and has served as associate director at MIRARCo (Canada). Dr. Grasselli is been involved on several researches ranging from practical rock support and ground control projects to more fundamental aspects on fluid flow and transport in porous fractured rock mass.

BIOGRAPHY of Prof. Diederichs:

Dr. Mark Diederichs is a professor of Geological Engineering at Queen's University. He has a PhD degrees from the University of Waterloo and is the recipient of the 2002 Rocha Medal and the 2003 CGS Colloquium Medal. He has over 15 years experience in consulting, research, technology development and technology transfer for the mining, tunneling and railway Industries related to geomechanics, rock tunneling, ground control and improvement, and rockfall safety in underground and surface cut environments. Current work include geological controls related to underground projects in Switzerland, Greece, Italy, Canada and Venezuela as well as ongoing research related to tunnel boring in rock.

BIOGRAPHY of Bryan Tatone:

Mr. Tatone is a graduate student at the University of Toronto. He is investigating the use of photogrammetric and topometric methods for rock mass characterization, with a particular focus on the effect of scale on roughness.

BIOGRAPHY of Stephanie Fekete:

Ms. Fekete is a graduate student at Queen's University. She is investigating the use of high-resolution Lidar in active tunneling applications for geomechanical characterization. She is working in collaboration with the Norwegian Geotechnical Institute.

BIOGRAPHY of Mathew Lato:

Mr. Lato is a graduate student at Queen's University and is an expert in static and mobile Lidar applications for rockfall hazard assessment and rock characterization. He has given numerous international lectures and workshops on the subject.