IAEG Commission 19

3D terrestrial laser scanning technology in the geosciences

International Association for Engineering Geology and the Environment

Secretary

Siefko Slob MSc
ITC
PO Box 6
7500 AA ENSCHEDE
The Netherlands
00 31 53 4874489 (Tel)
00 31 53 4874336 (Fax)
slob@itc.nl

Chairman

Dr Kennert Röshoff
Berg Bygg Konsult AB
Ankdammsgatan 20
171 43 SOLNA
Sweden
(Tel) 00 46 8 7595050
(Fax) 00 46 8 7595065
kennert.roshoff@bergbyggkonsult.se

To

To whom it may concern
Members of Commission 19

Date

12-Sept-06

Your reference

Subject

Minutes Commission meeting 2

Our reference

Commission meeting 2

IAEG Commission 19 - 3D terrestrial laser scanning technology in the Geosciences

Date:	09-09-06
Time	09:30-12:30
Location:	Nottingham, UK, IAEG 2006 congress venue
Present:	Röshoff, Feng, Slob, Schmitz, Morfeldt, Turner, Park, Runqiu, Whitworth, Bin, Lemy, Yuhuan, Faquan, Yongyue, Hack, Rengers

Agenda

1. Opening
2. Presenting the board of the commission
3. Objectives of the commission
4. Working program
5. Work progress
6. Technical presentations from members
7. Conclusions and closing

Appendix 1. List of attendance
Appendix 2. Presentation of results of questionnaire WG1: suggestion for working groups

1. Opening

Dr Kennert Röshoff, chairman of the Commission opens the second meeting of the Commission and welcomes all present.

2. Presenting the board of the Commission

The members of the Commission present themselves:

- Chairman: Dr. Kennert Röshoff, from Berg Bygg Konsult AB (BKK), a consulting company based in Solna, Sweden.
- Secretary: Ir Siefko Slob MSc, from ITC, Enschede, The Netherlands
- Technical adviser of this meeting: Dr. Quanhong Feng, from Berg Bygg Konsult AB (BKK).

Also all other persons in this meeting present themselves briefly. A list of all present with name, affiliation and email address is given below.

3. Objectives of the Commission

Röshoff explains the main objectives of IAEG Commission 19, which are the following:

- Investigate the various areas for 3D scanning technology to be used within geosciences
- Be a guide for the development of the technology
- A forum for discussion of ideas and practical use
- Establish quality standards of the method
- Establish methods and standards for calibration, accuracy etc for measurement
- Requirements for Hardware and Software tools for measurement, processing, analysis and visualisation

4 Work program

The main activities of the Commission consist of the following:

Roshoff: The Commission 19 should deliver in 2008 already a document with the main results

5. Work progress

Last year in May there was the first C19 meeting in Lyon. De minutes of this meeting can be found on the IAEG website under C19. The main results of this meeting a first working group (WG1) was established that should investigation the present status and application fields of 3D laser scanning. The WG 1 should result in a definition of a number of specific working groups.

The first idea was to have the individual members of WG1 come up with their own idea on status and application fields. Since the activity of the members was very low, it was decided by Roshoff and Slob to send out a questionnaire to both members of WG1 and all other members of the C19. The result of the survey were presented by Slob. The response to this questionnaire was also very small (only 7 of the 20+ members reacted). Therefore the results may not be at all representative. The questionnaire was done in 4 questions. The results of the survey is given in Appendix 2.

On the basis of these results a tentative list of working groups was proposed by Slob, which is the following:

- WG2: Data, Hardware and Software
- WG3: Survey

- WG4: Monitoring
- WG5: Rock Mass Characterisation

Discussion/ideas for things to be done in working groups.

Whitworth: Idea for WG to look at combination of 3D laser scanning and image interpretation of lineaments

Keith: Idea for WG to look at accuracy and precision issues. The use of targets and survey control and address the issue of ground control, problems of stitching different scans together.

Lemy: Research on noisy data, filters to remove noise dependent on distance. Filtering should be done on the raw data in polar coordinates, and not in xyz.

Feng: What will be important as a result of (one of the) working groups is to deliver a list of scanners, which one is suitable for which application. Some research has been done on this already, but they are all lab tests. We need more practical results and experiences.

Turner: Yes, a practical comparison of different manufacturers would be useful. Explain the differences in quality of scans for different (rock) materials, different moisture, vegetation, etc. It will be very useful to have a table for fieldsurvey, so that people will know, for which situations (different rocks, different climate, different access), they have to use which hardware and which survey setup.

Turner: Another issue is the standardization of data output and exchange. For airborne lidar there is for example the LAS data exchange format. There should be something similar for terrestrial data, which you could query easy over the internet for example. Now only in Ascii it is possible to exchange data, but it's too bulky and therefore not suitable as exchange format.

Turner: Contact or invite manufacturers of laser scanners and/or software developers to these kind of meetings to let them know what we as end-users need. Also a simpler questionnaire, max 2 pages to be handed out in several meetings in USA could provide some very useful feedback from end-users.

Rengers: Information of the C19 should still be disseminated through the official IAEG website (www.iaeg.info). Next to dissemination of documents and other information tot the other members of C19, some basic and simple information on 3D laser scanning in the Geosciences should be provided to outsiders.

6. Technical Presentations of Runqiu and Slob

- Mr. Huang Runqiu delivers a presentation on application of 3D laser scanning for a large dam project in China.

- Mr Siefko Slob delivers a presentation of a specific application of 3D laser scanning for rock mass characterisation

7. Other items, conclusions and action points of meeting-2 at IAEG2006, Nottingham

In 2008 a final report should be published of this Commission 19. This could be in the form of a Code Book for 3D terrestrial Laserscanning in the Geosciences. It should be covering the state-of-the-art in the technology.

A suggested Table of Contents is according to Roshoff:

1. What is 3D terrestrial laser scanning

2. Terminology
3. Standards/specifications
4. Links to manufacturers and software
5. Applications
    a. Survey
    b. Monitoring
    c. Rock mass characterization
    d. ……..

The results can be in the form of a practical manual being published in the IAEG bulletin for example. Turner is already busy in the USA with several states to develop such a manual under several research projects. There could be a very useful input from this side into this manual. This can be discussed further and information can be disseminated during the June 2007 landslide meeting in Vail, Co.

Turner: There is also a rock fall book coming out in early 2007 in which a few papers on laser scanning will be included.

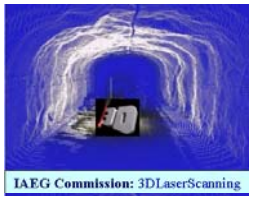
Roshoff further says that for the working groups only 1 person will chosen and made responsible for delivering output. This person can subsequently delegate work to other contacts. In this way we will avoid the situation that nobody takes initiative and cannot be held responsible. The responsibilities of the WG chairperson should be to :

- Search for papers and extent the network of resource persons to the C19
- Add relevant papers to the website
- Be responsible for his/her chapters in the code book
- List good/bad results and best practices of laser scanners

The July 2007 International Congress of the ISRM in Lisbon would be a very good venue to present papers on rock mass characterization and make contact with rock mechanics people working in this field. Possibly a Technical Commission between IAEG and ISRM can be defined on the same topic after the C19 period. Although the deadline for submission of abstracts has expired it is still possible to submit abstracts. The website is: http://www.isrm2007.org/

Action points:

⇒ **All: suggest change in working group division. Before 1 October 2006**
⇒ **All: individuals can volunteer to chair particular working groups preferable before November 2006**
⇒ **All: send copies of papers in digital format (preferable PDF) to Slob to be placed on the IAEG website.**
⇒ **All: send in abstracts to international ISRM congress Lisbon 9-13 July 2007**
⇒ **Roshoff: ask individuals to chair the working groups Before December 2006**
⇒ **Roshoff: contact ISPRS commission on 3D terrestrial laserscanning**
⇒ **Slob: update IAEG C19 website with additional information, documents**
⇒ **Slob: make new (simple) questionnaire to be handed out in meetings in USA by Turner – Send to Turner before October 2006.**
⇒ **Slob: Update the C19 email mailing list with new contacts from this meeting.**
⇒ **Turner: send draft version of field manuals on laserscanning once it has become available**



Appendix 1
Attendance list:

Name	Organization	Email	Interest	
			In WG	In which area
Feng Quanghong	BKK	feng@bergbyggkonsult.se	Yes	Fracture mapping
Robrecht Schmitz	RWE-Hambach mine	Robrecht.schmitz@rwe.com	Observer	
Daniel Morfeldt	Mineconsult	info@mineconsult.se	Observer	
Keith Turner	Colorado School of mines	kturner@mines.edu	Yes	Rock slope analysis
Hyeong-Dong Park	Seoul National University	hpark@snu.ac.kr	Yes	Rock slope and tunneling
Huang Rinqiu	Chengdu University of Technology	hrq@cdut.edu.cn	Yes	Rock slope and tunneling
Malcolm Whitworth	University of Portsmouth	Malcolm.whitworth@port.ac.uk	Yes	Landslide mapping and monitoring
Shi Bin	Nanjing University	shibin@nju.edu.cn	Yes	Tunnelling and underground space
Frank Lemy	ETH Zurich	frank.lemy@erdw.ethz.ch	Yes	Rock mass characterisation
Song Yuhuan	Institute of Geology and Geophysics CAS	Engineer2003@mail.igcas.ac.cn	Yes	Displacement monitoring
Wu Faquan	Institute of Geology and Geophysics CAS	wufaquan@mail.igcas.ac.cn	Yes	Rock slope stability
Shi Yongyue	Institute of Geology and Geophysics CAS	shiuongyue@mail.igcas.ac.cn	Yes	Rock slope stability
Robert Hack	ITC	hack@itc.nl	Observer	
Niek Rengers	ITC/IAEG	rengers@itc.nl	Observer	

Appendix 2
Presentation results
survey WG1 :

Results survey WG 1

IAEG C19

WG 1

- Objectives
  - Inventory of current status of 3D terrestrial laser scanning
  - Inventory of working areas (present or future) of 3D laser scanning in the Geosciences
- Tasks:
  - On the basis of the inventory define Working Groups and select members
  - Update and expand member and mailing list for C19

Questionnaire summary

- Inventory of status
- Inventory of working areas

- Based on 7 responses to questionnaire

A. Inventory of status

- Question 1.In which disciplines and application fields within the (technical) Geosciences do you see 3D terrestrial laser scanning being used at the moment?
- Question 2. For which application fields and disciplines do you find the following technical aspects and issues related to 3D laser scanning relevant and/or important?
  - Range-finding vs. Phase difference laserscanners
  - Use of colour/intensity values
  - Link to (3D) GIS/CAD & DGPS

Response to question 1

- Which disciplines do you see laser scanning being used?

1. Geotechnical engineering – yes, but occasionally - in tunnelling
2. Civil Engineering – yes, but occasionally
3. Mining/Environmental – yes/no
4. Engineering Geology/Geology - no

Response to question 1

- Which application fields do you see laser scanning being used?

1. Discontinuity mapping – yes, but occasionally
2. Survey – yes, but occasionally
3. Monitoring – yes/no
4. Visualisation – yes/no
5. Water leakage mapping - no
6. Documentation - no

Response to question 2

- Range-finding (low precision, large range):
  - Visualisation of complex sites
  - Rapid damage assessment (e.g. after dike burst, earthquake, landslide, etc)
  - All the outside work, rock surfaces, landscape
  - DEM, visualizations, discontinuity mapping assessment
  - Civil – survey
  - Environmental geotechnology

Response to question 2

- Phase-difference (high precision, small range):
  - Determining the orientation of rock mass discontinuities
  - Determining the roughness of rock mass discontinuities
  - 3D site modeling, DEM generation
  - Tunnel projects, underground structures
  - Monitoring
  - Geotechnical engineering, Geological hazard monitoring

Response to question 2

- Use of colour values (with digital imagery)
  - Mass movement monitoring;
  - Deformation monitoring on geological structures
  - Visualisation
  - Engineering geology, soil behavior analysis
- Use of intensity values:
  - Discontinuity mapping assessment

Response to question 2

- Link to (3D) GIS/CAD & DGPS
  - Mass movement monitoring;
  - "We only use once to export the laser mesh to our open-source VR-model. It works well. I would like to work more with this aspect: How to SHOW and PRESENT the huge quantities of laserscanning data to the client and the other actor in a project."
  - Survey (3x)
  - GIS in environmental geotechnology

B. Inventory of working areas

- Question 3. Please add relevant working areas (engineering disciples as well as application fields)
- Question 4. Please Indicate relevancy of present and future 3D terrestrial laser scanning for the working areas at a scale between 1 and 5:
  1. Not relevant
  2. Slightly relevant
  3. Relevant
  4. Very relevant
  5. Essential

Question 3: Engineering disciplines within the Geosciences

- Mining
- Civil
- Environmental
- Geotechnical
- Harbour (control of the dam and bar stabilities) and coast (sand erosions and deposits)
- Engineering Geological
- Environmental Geotechnical

Q3: Application fields (1)

- Monitoring
  - Mass movement monitoring
  - Deformation monitoring of engineering structures (dams, tunnels, bridges, buildings)
  - Volume monitoring (extraction or suppletion)
  - Deformation monitoring on geological structures

Q3: Application fields (2)

- Surveying
  - Tunnel surveying
  - 3D site modeling, DEM generation
  - Geomorphometry and landscape modelling
- Visualisation
  - Visualisation of complex sites
  - Rapid damage assessement (e.g. after dike burst, earthquake, landslide, etc)

Q3: Application fields (3)

- Discontinuity mapping
  - Determining the orientation of rock mass discontinuities
  - Determining the roughness of rock mass discontinuities
- Water leakage mapping
- Documentation

Question 4: Relevancy

Engineering Disciplines	Mining		Civil		*Geotechnical*		Environmental		Coastal	
Application fields	Present	Future	Present	Future	Present	Future	Present	Future	Present	Future
Mass movement monitoring	2 3 2 5	2 5 2 5	3 2 2 5	4 3 2 5	3 3 2 5	4 4 2 5	3 1 5	4 1 5	3	5
Deformation monitoring	4 2 2 5	4 4 2 5	4 3 2 5	4 3 2 5	3 3 2 5	4 4 2 5	2 1 4	2 1 4		
Volume monitoring	3 3 3 5	3 5 3 5	3 2 3 5	4 2 3 5	3 2 3 5	4 3 4 5	3 1 4	4 1 4		
Tunnel surveying	4 4 5 3 4	4 5 5 4 4	4 5 4 5	4 5 4 5	4 4 5 4 5	4 5 4 5	4 2 4	4 2 4		
3D site modeling, DEM generation	4 5 4 5	4 5 4 5	4 3 4 5	4 5 4 5	4 4 4 5	4 5 4 5	4 4 5	4 4 5		
Visualization of complex sites	2 4 4 5	2 5 4 5	3 3 3 4 5	3 5 3 4 5	3 3 3 4 5	3 5 5 4 5	3 4 5	3 4 5		4
Rapid damage assessment	1 3 2 4	1 3 2 4	3 3 2 4	4 4 2 4	3 5 2 4	4 3 5 2 4	3 2 4	4 2 4		
Determining the orientation of discontinuities	3 4 3 3	4 5 4 3	3 3 3 3	4 3 4 3	3 4 3 3 3	4 3 4 4 3	3 3 3	4 4 3		
Determining the roughness of discontinuities	3 4 2 3	3 5 2 3	3 3 2 3	3 3 2 3	3 4 2 3	3 3 4 2 3	3 1 3	3 1 3		

Definition of working groups

- Based on application, e.g.:
  - Survey
    - Tunnelling
    - Topography – site characterisation
    - Damage assessment
  - Monitoring
    - large-scale mass movement
    - small-scale deformation
    - volumes
  - Rock mass characterisation
    - fracture mapping
    - digital outcrop mapping
    - documentation
- Based on data, hardware and software issues

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