**TENTATIVE PROGRAMME**

<table>
<thead>
<tr>
<th>Saturday 30/09/2017</th>
<th>Sunday 1/10/2017</th>
<th>Monday 2/10/2017</th>
<th>Tuesday 3/10/2017</th>
<th>Wednesday 4/10/2017</th>
<th>Thursday 5/10/2017</th>
<th>Friday 6/10/2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISRM Board Meeting</td>
<td>ISRM Board Meeting</td>
<td>Workshop ISRM Commission Meetings</td>
<td>Technical Session</td>
<td>Morning Refreshments</td>
<td>Technical Session</td>
<td>Lunch</td>
</tr>
<tr>
<td>Workshop</td>
<td>Workshop ISRM Commission Meetings</td>
<td>Technical Session</td>
<td>Technical Session</td>
<td>Afternoon Refreshments</td>
<td>Technical Session</td>
<td>Lunch</td>
</tr>
<tr>
<td>Board Dinner</td>
<td>Network Function</td>
<td>Conference Dinner</td>
<td>Palabora Mine</td>
<td>Tau Tona Mine</td>
<td>Chapman’s Peak</td>
<td></td>
</tr>
</tbody>
</table>

**WHO SHOULD ATTEND**

- Rock engineering practitioners
- Researchers
- Academics
- Mining engineers
- Civil engineers
- Petroleum engineers
- Engineering geologists.

**BACKGROUND**

The 2017 ISRM International Rock Mechanics Symposium is to be held in Cape Town. The conference theme is ‘Rock Mechanics for Africa’. Mining has traditionally been a mainstay of African economies, while Oil and Gas industries are rapidly growing throughout Africa. Infrastructure is being developed to support these industries. Rock engineering design is and therefore will continue to be essential for the growth of the continent. Prior to the conference, the ISRM Board, Council and Commission meetings will take place. Technical visits are being arranged for after the conference.

**TECHNICAL VISITS**

The following technical visits are confirmed for the conference:

- Palabora Mine
- Tau Tona Mine
- Chapman’s Peak

**EXHIBITION/SPONSORSHIP**

Sponsorship opportunities are available. Companies wishing to sponsor or exhibit should contact the Conference Co-ordinator.

**For further information contact:**
Raymond van der Berg, Head of Conferencing
SAIMM, P O Box 61127, Marshalltown 2107
Tel: +27 (0) 11 834-1273 / 7 · E-mail: raymond@saimm.co.za
Website: http://www.saimm.co.za

**Supported by**
KEYNOTES

Rock engineering as a creator of value
T.R. Stacey, University of the Witwatersrand, South Africa

Mythperceptions in rock engineering
N. van der Merwe, Stable Strata, South Africa

Lessons from large failures: geology, stress and support
N. Barton, Nick Barton & Associates, Norway

Stress measurements for underground powerhouses – three recent cases
L. Lamas, ISRM

The Grosvenor strata control journey: learning and adapting from new and challenging experiences
P.S. Buddery, Anglo American Met Coal, Australia

How rock mechanics can help oil well drilling — Latest developments
S. Fontoura, Pontifical Catholic University of Rio de Janeiro, Brazil

ABSTRACTS

Stability analysis on the layered surrounding rock mass of large underground powerhouse of Wudongde Hydropower Station
China Three Gorges Corporation, China

Rock anchoring beam excavation and shaping technology for the underground powerhouse of Hydropower Stations
China Three Gorges Corporation, China

Deformation and stability analysis for the large-scale tailwater surge chamber of the Baihetan Hydropower Station
China Three Gorges Corporation, China, Hydro China Itasca Research and Development Center, Powerchina Huadong Engineering Corporation Limited, China

Deformation and failure analysis of large underground hard-rock chambers under high geo-stress: A case study of the underground powerhouse on the right bank of Baihetan Hydropower Station
China Three Gorges Corporation, China

Research of deformation and failure characteristics, mechanism, and engineering countermeasures for surrounding rocks in underground chambers of Baihetan Hydropower Station
China Three Gorges Corporation, HydroChina Itasca Research and Development Center, Powerchina Huadong Engineering Corporation Limited, China

The dam foundation grouting engineering management based on 3D geological model and monitoring system
China Three Gorges Corporation, China

Research of countermeasures for excavation of medium- and high-stress basalts at Baihetan Hydropower Station
China Three Gorges Corporation, China

Research of excavation and shaping of medium-high-stress basalt underground chambers at Baihetan Hydropower Station
China Three Gorges Corporation, China

Research of excavation and support measures for columnar jointing sections in the diversion tunnel of Baihetan Hydropower Station
China Three Gorges Corporation, China

Discussion on the excavation and support technology of underground chambers in the steep, small-inclined-angle rock stratum at Wudongde Hydropower Station
China Three Gorges Corporation, China

Research of countermeasures for phyllite excavation in the water diversion tunnel of Nepal Upper Madi Hydropower Station
China Three Gorges Corporation, China

Research of key technology for excavation and shaping of large-scale granite chambers in the Three Gorges Underground Powerhouse
China Three Gorges Corporation, China

A case study on a risk based approach to stope design
SRK, South Africa

Conceptual design for an arched sub-level pillar at Lace Diamond Mine in Kroonstad South Africa
Brentley, Lucas and Associates, South Africa

Comparison between thin spray on liners and shotcrete as surface support mechanisms in tunnels
University of Cape Town, South Africa

Time dependent failure of open stopes at Target Mine
Brentley, Lucas and Associates, South Africa

Reassessing continuous stope closure data using a limit equilibrium displacement discontinuity model
University of Pretoria, South Africa

Geomechanical evaluation enabled successful stimulation of apollonia tight chalk reservoir in Abu-Gharadig Basin, Egypt
Khaldia Petroleum Company, Egypt

A review on rockburst risk assessment in tunnelling and mining
Institute of Rock Mechanics and Tunnelling, Graz University of Technology, Austria

Techniques for three-dimensional displacement vector using ground-based interferometric synthetic aperture radar
Hexagon Mining, South Africa, IDS GeoRadar, Italy

Rock mechanics challenges during construction of the Cheves Hydro Power Project - a case study
South Africa

An investigation in to the uncharacteristic in-stope support behaviour on the UG2 Reef horizon at Lonmin’s K3 shaft
Lonmin, South Africa

Slope design aspects considerations for shallow open pit mines: A case study at Mamatwan Mine, Northern Cape Province
University of Johannesburg, South Africa

A novel approach to establish the Merensky reef crush pillar stability and the impact of sidings and pillar holing width
Bafokeng Rasimone Platinum Mine, South Africa
Back analysis of Merensky reef cube strength
Bafokeng Rasimone Platinum Mine, South Africa

Reef drive protection pillar stability assessment through numerical modelling
Advisian, South Africa

Assessment of the risks in undermining of a surface stream in a shallow coal mine
Glencore, South Africa

Coal pillar stooping – Partial extraction of coal pillars ensuring panel stability
Glencore, South Africa

Coal pillar stooping – Assessing the stability of snooks
Glencore, South Africa

The effect on undercutting an unstable layer on roof stability
Bafokeng Rasimone Platinum Mine, South Africa

Stability of middling between two tabular chrome seams
Hernic, South Africa

Assessing roof stability in a coal mine
South Africa

Extraction of hard rock strike pillars
Bafokeng Rasimone Platinum Mine, South Africa

Investigation of a failure associated with a major shear zone in the Main Pit Cut 3 West, at Letseng Diamond mine
Lesotho Letseng Diamonds, University of KwaZulu Natal, South Africa

Advanced information on rock mass properties in large open pits by analysing production drill rig parameters in real time
Groundwork Consulting, South Africa

Case studies demonstrating advances in geotechnical instrumentation and monitoring and the decision making implications for mine rock engineers
Groundwork Consulting, South Africa

Rock engineering considerations for the extension of a vertical rectangular shaft in a jointed rockmass adjacent to a large open-pit
GeoSindile (Pty) Ltd, South Africa

Assessment of vertical shaft stability in the zone of influence of a large open-pit
GeoSindile (Pty) Ltd, South Africa

The mineralogical and geotechnical properties of the sandstone 'parting' between the Alfred seam and the Gus seam in the Magdalena Colliery, Dundee
South Africa University of KwaZulu-Natal, Buffalo Coal, South Africa

Application of controlled blasting to minimize limit wall damage at Letseng Diamonds Lesotho
University of KwaZulu-Natal, South Africa

Full scale dynamic tests of a ground support system using high-tensile strength chain link mesh in El Teniente Mine, Chile
Chile University / Codelco El Teniente, University of Applied sciences Zurich, Geobrugg AG, Santa Maria University, Geobrugg Andina Group T University / Geobrugg Southern Africa (Pty) Ltd, Chile, South Africa

Improving the mining efficiencies as a result of a new support design at Unisel Gold Mine, Welkom, South Africa
Brentley, Lucas & Associates (Pty) Ltd, South Africa

Rockburst prevention due to destress blasting in roof competent rocks in hardcoal longwall mining
Institute of Geonics of the Czech Academy of Sciences, Czech Republic

Optimizing stoping panel spans at an Eastern bushveld platinum mine
Impala Platinum, South Africa

Pillar scaling and pillar fracturing in deep level gold mines in South Africa 1Deep level gold mine
The University of the Witwatersrand, South Africa

Remediation of abandoned mines for residential development
Oweis Engineering Inc, The Falcon Group, USA

A model-oriented, remote sensing approach for the derivation of numerical modelling input data: Insights from the Hope Slide, Canada
Simon Fraser University, Canada

A Study of multi-reef pillar extraction in the Carletonville area
SibanyeGold, The University of the Witwatersrand, South Africa

Parameters required for the design of rock support in highly stressed rock masses
Norwegian University of Science and Technology, Norway

A tool for the evaluation of departmental effectiveness
Advisian, South Africa

Simultaneous extraction of three coal seams with stowing – A case study
CSIR-Central Institute of Mining & Fuel Research, India

Preliminary investigation to areal shape effect of pillar strength
University of Pretoria, South Africa

Towards a formal Rock Engineering Qualification in the South African Mining setup
University of Pretoria, South Africa

Development of a site specific floor deformation index to assess floor heave risks
Anglo American Met Coal, Anglo American Grosvenor Mine, Australia

Characterization and numerical modelling of standard and cabled strapped pillars in a hematite mine
University of Vigo, Spain

Application of rock mass classification and blastability index for the improvement of wall control in hard rock open pit mining: a case study
The University of the Witwatersrand, South Africa

Comparison of observational, empirical and 3D discrete numerical methods to estimate subsidence over longwall coal faces
University of Vigo, Itasca Consultores SL, Spain

A multi-objective hybrid prediction model of slope deformation based on fuzzy optimization algorithm
Yangtze River Scientific Research Institute, China

Numerical simulation of fully grouted rock bolts by considering the non-linear bond-slip behaviour
Nanyang Technological University, Singapore

Otjikoto gold mine – a case study on the pit slope design
SRK, South Africa
Modelling of structural controlled slope failure using photogrammetry techniques  
SRK, South Africa

The effect of seismic sensor frequency on the results of routine seismic monitoring analyses techniques  
Australian Centre for Geomechanics, Australia

Microseismicity characteristic and rockburst risk mitigation during the breakthrough in deep-buried tunnels of the Jinping-II Hydropower Station, China  
Chinese Academy of Sciences, China

A holistic open-pit mine slope stability index using Artificial Neural Networks  
University of Johannesburg, South Africa

An investigation on the relationships between the petrographic, physical and mechanical characteristics of sandstones from Newspaper Member of the Natal Group  
University of KwaZulu University of Johannesburg, South Africa

The significance of identifying potential failure mechanisms from conceptual to design level for open pit rock slopes  
University of KwaZulu, University of Johannesburg, South Africa

Stability of large cavern in anisotropic rock  
Kajima Corporation, Japan

Case study to achieve gas-tightness and stability of large cavern in Kurashiki LPG stockpiling base, Japan  
Kajima Corporation, JOGMEC Japan Oil Gas and Metals National Corporation, Japan

Support method of hard rock in underground engineering with high geo-stress: A case study of the Baihetan underground cavern, China  
Chinese Academy of Sciences, China

A critical review of the findings from in situ stress measurements conducted in Southern Africa during the past ten years  
Hands on Mining cc, Groundwork Consulting, South Africa

An empirical and numerical approach to quantifying raise-bore hole stability  
Middindi Consulting (Pty) Ltd, University of Pretoria, South Africa

Slope stability of soft material benches in open pit mining  
Middindi Consulting (Pty) Ltd, South Africa

Microseismic events for slope stability analysis – A case study at an open pit mine  
CSIRO Energy, Australia

Modeling hydraulic fracturing in hard rock using a continuous-discontinuous method  
Chinese Academy of Sciences, China

Mining with crush pillars  
Lonmin Platinum, University of Pretoria, South Africa

Unravelling the structural mysteries of the Bermuda Triangle at Lonmin’s Saffy Shaft Lonmin Plc  
Terra Explora Consulting, South Africa

A practical approach to quantifying the effects of pillar mining in a rigid hard rock environment  
Lonmin Plc, South Africa

Understanding the influence of geological structures – an often overlooked important aspect in the stability of operating mines  
Independent Consultant, Lonmin Platinum, Canada, South Africa

The effectiveness of a coupled large annulus resin bolting system installed in a conventional narrow tabular orebody utilizing conventional equipment  
Lonmin Plc, South Africa

Crack propagation energy determination for rock materials under static and impact loading  
Karadeniz Technical University, Turkey

Cautious balst design and practice in close proximity to a railway tunnel and apartment buildings  
Middle East Technical University, Turkey

Fault rock mass characterization using descriptive statistics during preliminary geotechnical investigation Pahl Fault Zone (Windhoek), Namibia  
China Geosciences University, Letseng Diamonds, Geological Survey of Namibia, China, Namibia

Evaluation of crack displacement in underground excavations using wireless technology crack meters  
University of the Witwatersrand, South Africa

Stable beam span re-design and support optimization for a shallow hard rock bord and pillar mine: The case of Unki mine, Zimbabwe  
Unki mines (Pvt) Ltd, Zimbabwe

Excavation-induced seismicity: mechanism and implications  
Nanyang Technological University, Tsinghua University, China

The impacts of plastic deformation on productivity in low-permeability reservoirs during hydraulic fracturing  
Petro-Geotech Inc., Canada

Two phase flow coupled to geomechanics by dual porosity model: simulating fractured reservoirs by finite element method  
Petro-Geotech Inc., Canada

Induced stresses and SRV calculation near a hydraulic fracture in the naturally fractured reservoir  
Petro-Geotech Inc., Canada

Relating source mechanisms to damage phenomena in platinum mines of the western Bushveld complex  
Yuba, South Africa

Numerical simulation of a segmental lining and rock mass interaction  
Graz University of Technology, Austria

Numerical detection of voids within a pea gravel backfilled annular gap of a TBM using GPR  
Graz University of Technology, Austria
<table>
<thead>
<tr>
<th>Title</th>
<th>Authors and Affiliations</th>
</tr>
</thead>
<tbody>
<tr>
<td>A numerical study of the influence of pre-existing discontinuities on the hydraulic fracturing process</td>
<td>Amirkabir University of Technology, Iran</td>
</tr>
<tr>
<td>Continuum modelling of the behaviour of high rock slopes</td>
<td>Amirkabir University of Technology, Iran</td>
</tr>
<tr>
<td>Performance evaluation of the Paboase crown pillar at Chirano gold mines in Ghana</td>
<td>Kinross</td>
</tr>
<tr>
<td>Debris flow impact on flexible protection barriers small scale tests</td>
<td>University of Calabria, Italy</td>
</tr>
<tr>
<td>Supercritical CO₂ fracturing on shale under true triaxial stress conditions</td>
<td>Northeastern University, Chinese Academy of Sciences, China</td>
</tr>
<tr>
<td>Structurally controlled slope instability in residual soils at a southern African mine</td>
<td>SRK, South Africa</td>
</tr>
<tr>
<td>An overview of safety critical monitoring at Kao Mine, Lesotho</td>
<td>SRK South Africa</td>
</tr>
<tr>
<td>Optimizing presplit performance in highly jointed rock formations</td>
<td>Curtin University-Western Australian School of Mines, Australia</td>
</tr>
<tr>
<td>Revised pillar design for a Zimbabwe bord and pillar operation</td>
<td>SRK Consulting (Pty) Ltd, South Africa</td>
</tr>
<tr>
<td>using a combination of empirical, linear elastic and non-linear analysis</td>
<td>SRK Consulting (Pty) Ltd, South Africa</td>
</tr>
<tr>
<td>Sand management and CHOPS with thermally effects</td>
<td>Petro-Geotech Inc., South Africa</td>
</tr>
<tr>
<td>Hydraulic fracturing initiation and the induced stresses near a horizontal well in a thermo-poroelastic medium: Model and applications to enhanced geothermal system</td>
<td>Petro-Geotech Inc., South Africa</td>
</tr>
<tr>
<td>Modelling salt rock dissolution in the foundation of a large dam</td>
<td>Tractebel France, Gennevillers, Independent Consultant, France, Belgium</td>
</tr>
<tr>
<td>Stability of large underground rock caverns for crude oil storage operated below atmospheric pressure</td>
<td>Geostock Entrepose, France</td>
</tr>
<tr>
<td>Discrete element modeling of rock cutting experiments under confining pressure</td>
<td>University of Mons, Belgium</td>
</tr>
<tr>
<td>Controlled damage - unfolding the design, risk and cost</td>
<td>AEL, South Africa</td>
</tr>
<tr>
<td>Support design for tunnels with large overburden in weak rock</td>
<td>Graz University of Technology, Austria</td>
</tr>
<tr>
<td>Numerical modeling of the shallow crystal stress field in Chinese mainland with the constraint of in situ measured stress</td>
<td>China Earthquake Administration, China</td>
</tr>
<tr>
<td>The application of risk assessments in rock engineering design of open pit mines</td>
<td>SRK Consulting (Pty) Ltd, South Africa</td>
</tr>
<tr>
<td>Use of plastic composites as friction rock bolt materials</td>
<td>Karadeniz Technical University, Turkey</td>
</tr>
<tr>
<td>Mechanism of the Taihongcun landslide triggered by the 2008 Wenchuan earthquake in Beichuan County</td>
<td>Chinese Academy of Sciences, China</td>
</tr>
<tr>
<td>The evaluation of rock bolt as rock support in underground gold mine Pongkor, west Java, Indonesia</td>
<td>Trisakti University, Indonesia</td>
</tr>
<tr>
<td>Assessment of closure by timber pack assessment method and its comparison to MAP3D convergence</td>
<td>University of the Witwatersrand, South Africa</td>
</tr>
<tr>
<td>Review of remnant mining practices in South African Gold Mines</td>
<td>University of the Witwatersrand, South Africa</td>
</tr>
<tr>
<td>Use of numerical modelling techniques to predict the extent and depth of failure of rock around a tunnel at intermediate depth as a way of validating the observations made by physical models</td>
<td>University of the Witwatersrand, SRK Consulting (Pty) Ltd, South Africa</td>
</tr>
<tr>
<td>Geotechnical data for Ivanplats</td>
<td>Platreef project Ivanplats (Pty) Ltd, SRK Consulting (Pty) Ltd, South Africa</td>
</tr>
<tr>
<td>Geological- and hydrogeological settings for rock engineering an example for grouting design at Åspö Hard Rock Laboratory, Sweden</td>
<td>Chalmers University of Technology, Norconsult AB, Sweden</td>
</tr>
<tr>
<td>Acoustic approach to estimation of rock mass state and prediction of induced seismicity parameters: theory, laboratory experiment and case study</td>
<td>Russian Academy of Science, Russia</td>
</tr>
<tr>
<td>Issues related to the long-term stability of unlined water tunnels – a case review</td>
<td>Norwegian University of Science and Technology (NTNU), Norway</td>
</tr>
<tr>
<td>The sub surface profiler: A giant leap for ground penetrating radar -</td>
<td>REUTECH Mining, South Africa</td>
</tr>
<tr>
<td>Borehole stability and sand production in gas reservoirs</td>
<td>Aristotle University of Thessalonik, SINTEF, Petroleum Research, Greece, Norway</td>
</tr>
<tr>
<td>Application of digital photogrammetry in QA/QC of drill core measured structural data</td>
<td>SRK Consulting (South Africa) (Pty) Ltd, South Africa</td>
</tr>
<tr>
<td>Design of weathered slopes to improve stability and economics</td>
<td>Kansanshi Mine, Zambia</td>
</tr>
<tr>
<td>Rock failure modes under uniaxial compression and indirect tension</td>
<td>Indian Institute of Technology Kharagpur, India</td>
</tr>
</tbody>
</table>
Abstracts received for AfriRock Symposium 2017 · 30 September–6 October 2017

Experimental studies of variably saturated flow from a horizontal discontinuity to the vertical with and without an intersection
University of Pretoria, 2GaGE Consulting, South Africa

Characterizing microtremor signals of a slope with deep-seated gravitational deformation
National Taipei University of Technology, Taiwan

Influence of scale on fluid flow through fractured rock masses
BG Tech Soil and Rock Engineering, Votorantim Metais, Brazil

Benchmarking of debris flow experimental tests using combined finite-discrete element method, FEMDEM
University of Turin, Imperial College of London, Italy, London

Reducing the risk to a mining project through timely and appropriate geotechnical data collection
First Quantum Minerals Limited, Zambia

Influence of heterogeneity at grain-scale on rockburst proneness Investigations on artificial samples
University of Technology, Austria

Influence of rocks’s structure at grain-scale on rockburst proneness first investigations
University of Technology, Austria

Development of a rocks mass quality model for an open pit mine
Norwegian University of Science and Technology (NTNU), Norway

Contributions to geomechanical stope optimization at Goldcorp
Eleonore Mine Goldcorp, Laval University, Canada

Numerical simulation of hydraulic fracturing process on composite rock mass
Tongji University, China University of Mining & Technology, China

Failure and debris mechanism of karst caves during drill and blast tunnelling
Tongji University, China University of Mining & Technology, China

Microseismic monitoring and stability analysis of deep underground powerhouse at the Lianghekou hydropower station, Southwest China
Powerchina Chengdu Engineering Corporation Limited, Sichuan University, China

Combining different vehicle LiDAR dates to discuss the characteristic of potential geological disaster along changchun Shrine Trail
National Taipei University of Technology, China

Numerical modelling of longwall goaf dynamics and properties for gas drainage design
CSIRO, Australia

Stability analysis and failure evolution of large-scale underground caverns in bedded rock masses from microseismic monitoring
Sichuan University, Powerchina, Chengdu Engineering Corporation Limited, China

PPV’ to PPV: towards estimating the site effect due to surface waves generated along excavation surfaces
University of Leeds, SRK Pty (Ltd), Australian Centre for Geomechanics, United Kingdom, South Africa, Australia

Rock engineering for Boschkop intake works
Geoid Geotechnical Engineers, South Africa

Shaft sinking on the platreef project
Ivanplats, South Africa

The application of three-dimensional numerical modelling for defining the influence of slope curvature on stability for an open pit mine in Lesotho
SRK Consulting, South Africa

Numerical model calibration: Process or luck?
University of Pretoria, Middindi Consulting (Pty) Ltd, South Africa

Overburden response to longwall mining
CSIRO, Australia

Design of an in situ testing device for the backfill of mechanised driven tunnels in hard rock
Graz University of Technology,

Cost analyses of a mine roadway driven by conventional and mechanized methods
Bulent Ecevit University, Turkey

Analytical and experimental analysis of hard rock indentation process
Ecole Nationale d’Ingénieurs de Tunis, Université de Tunis El Manar, Tunisia

Progress of brittle micro-fracturing in crystalline rocks under cyclic loading conditions
Queen’s University, Canada

Predictive strategies and risk management for rockbursting in deep tunnel and mine access development
Queen’s University, Canada

Raisebore camera survey using drones
OceanaGold Corporation, Philippines

Reinforced rock landfill design from coal boiler bottom ash, fly ash and geosynthetics- Şırnak case assessment on restoration
Şırnak University, Turkey

Observational studies in South African mines to mitigate seismic risks
CSIR, The University of the Witwatersrand, Council for Geoscience, Ritsumeikan University, SATREPS, Japan, South Africa, Switzerland, Australia, Italy, USA

InSAR monitoring for mines: an integrated approach, ‘TRE ALTAMIRA
Optron Pty, Italy

Experimental study on the influence of tunnel excavation on neighboring underground structure
Konkuk University, Korea

An experimental study of wave propagation through fluid-filled rock joints
The Hong Kong Polytechnic University, Hong Kong

Technology transfer on minimising seismic risk in the platinum mines
SIM Mining Consultants (Pty) Ltd, Middindi Consulting (Pty) Ltd, Simulated Training Solutions (Pty) Ltd, South Africa

The determination of crustal stress direction based on borehole geometric shape using panoramic stereopair imaging technology
Chinese Academy of Sciences, China