

AIMS NATIONAL CONFERENCE 2023

HYATT REGENCY, SYDNEY - 13 - 15 SEPTEMBER 2023



AGENDA 2023

Wednesday 13 September **CPD POINTS - 3 Mine Survey & 0.5 Survey Practice**

12:00 PM	Lunch & Conference Registrations	Maritime Foyer
1:00 PM	Workshop 1 - CR Kennedy - Monitoring Solutions for the life of mine <i>Presented by Richard Ingham</i>	Maritime 1 & 2
1:45 PM	Workshop 2 - Trimble/UPG - Trimble Positioning Services and Software for Mining <i>Presented by David Corcia, Russell Box, Dan Hughes, Brent Dawson & Sean Baxter</i>	Maritime 1 & 2
2:15 PM	Workshop 3 - Maptek - Python for Mining Surveyors - An Introductory Workshop <i>Presented by Ben Connelly</i>	Maritime 1 & 2
2:45 PM	Afternoon Tea	Maritime Foyer
3:15 PM	Workshop 4 - Position Partners - Applications of autonomous sensor networks for monitoring track and key rail assets <i>Presented by Anthony Nieves</i>	Maritime 1 & 2
3:45 PM	Workshop 5 - Deswik - Tips and tricks in using Deswik CAD and the point cloud functions <i>Presented by Stephen Rowles</i>	Maritime 1 & 2
4:15 PM	Workshop 6 - CR Kennedy - UAV Solutions for the mining industry <i>Presented by Anthony Boyle, Francois du Bois & Zoot Ngui</i>	Maritime 1 & 2
5:00 PM	Welcome Drinks with Sponsors <i>Exhibition Area</i>	Maritime 3 & 4
6:15 PM	Networking Welcome Dinner <i>Sydney Harbour Crusie</i>	Depart Hotel Foyer

Thursday 14 September CPD POINTS - 1.25 Mine Survey & 3.75 Survey Practice

8:00 AM	Conference Registrations	Maritime Foyer
8:00 AM	Welcome Coffee + Sponsor Networking <i>Coffee Sponsored by FYFE</i>	Maritime 3 & 4
8:45 AM	Conference Welcome + MC Introduction <i>MC - Stephanie Brantz</i>	Maritime 1 & 2
8:50 AM	AIMS President Welcome <i>Shane Watson, AIMS President</i>	Maritime 1 & 2
8:55 AM	Surveyor General Presentation + Update from NSW Spatial Services and BOSSI <i>Narelle Underwood - NSW Surveyor General</i>	Maritime 1 & 2
9:55 AM	Identifying instabilities early - Slope stability monitoring with InSAR <i>Jason Pretorius</i>	Maritime 1 & 2
10:20 AM	Platinum Sponsor Address - CR Kennedy <i>CR Kennedy</i>	Maritime 1 & 2
10:30 AM	Morning Tea + Sponsor Networking <i>Morning Tea sponsored by Collinsville Open Cut, GLENCORE</i>	Maritime 3 & 4
11:00AM	Future Demand, Supply and Skills Gap for Surveying and Geospatial Professionals <i>Michelle Blicavs - CEO of Consulting Surveyors National</i>	Maritime 1 & 2
11:30 AM	Multispectral drone surveys for characterisation of spoil piles <i>Dr. Simit Raval, Assoc. Prof. School of Minerals and Energy Resources Engineering - University of New South Wales</i>	Maritime 1 & 2
11:55 AM	From Hydro to Underground. Advice for changing disciplines and why adding a hydrographic surveyor can be beneficial to your team. <i>Tashka Goswell</i>	Maritime 1 & 2
12:20 PM	Gold Sponsor Address - MAPTEK <i>Maptek</i>	Maritime 1 & 2
12:30 PM	Lunch + Sponsor Networking	Maritime 3 & 4

1:40 PM	Overcoming Obstacles: Leveraging Post-Processed Kinematic (PPK) Technology for Rapid Road Corridor Survey in Ecuador <i>Brenton Stenning</i>	Maritime 1 & 2
2:05 PM	History of Mining in Broken Hill <i>David Hurley</i>	Maritime 1 & 2
2:30 PM	Scanning Voids 300-500 meters below the surface. <i>David Cox & John Lupton</i>	Maritime 1 & 2
2:55 PM	Sponsor Presentation GOLD <i>Deswik</i>	Maritime 1 & 2
3:05 PM	Afternoon Tea <i>Afternoon Tea sponsored by Collinsville Open Cut, GLENCORE</i>	Maritime 3 & 4
3:35 PM	Facing the challenges of Surveying education <i>Dr Craig Roberts, Senior lecturer in Surveying, GPS + Geodesy, University of New South Wales</i>	Maritime 1 & 2
4:05 PM	AIMS AGM	Maritime 1 & 2
5:05 PM	Drinks + Sponsor Networking	Maritime 3 & 4
7:00 PM	Formal Dinner <i>Including Guest Speaker - Peter Baines OAM</i>	Maritime 1 & 2

Friday 15 September **CPD POINTS - 0.75 Mine Survey & 4 Survey Practice**

8:00 AM	Welcome Coffee + Sponsor Networking <i>Coffee Sponsored by FYFE</i>	Maritime 3 & 4
8:45 AM	MC Welcome <i>Stephanie Brantz</i>	Maritime 1 & 2
8:50 AM	Mines and Pubs and their historical importance in society <i>Ed Tonks, Mining Historian</i>	Maritime 1 & 2

9:35 AM	Highwall Mapping with P4 RTK Drone <i>Brendan Nichols</i>	Maritime 1 & 2
10:00 AM	Sponsor Address - GOLD <i>UPG / Trimble</i>	Maritime 1 & 2
10:10 AM	Morning Tea <i>Morning Tea sponsored by Collinsville Open Cut, GLENCORE</i>	Maritime 3 & 4
10:50 AM	Shaping of mine overburden for natural landform rehabilitation at Mangoola Coal <i>Ricki Clifford</i>	Maritime 1 & 2
11:15 AM	Promotion of Surveying Careers in NSW <i>Cathy Moses, NSW Surveying Taskforce Manager</i>	Maritime 1 & 2
11:45 AM	Target Resolution: Practicability for Terrestrial Laser Scanning (TLS) Resolution <i>Mansoor Sabzali, University of Newcastle</i>	Maritime 1 & 2
12:15 AM	Sponsor Address - GOLD <i>Position Partners</i>	Maritime 1 & 2
12:25 AM	Lunch + Sponsors Networking	Maritime 3 & 4
1:15 PM	Keynote Speaker - Mental Health <i>Dan Hunt, Co-founding Director & CEO - Mental Health Movement</i>	Maritime 1 & 2
2:15 PM	Evaluation of Australian-made GNSS-IoT Sensor Performance in EDM Calibration Site and Waste Landfill Site <i>Jun Wang, Lee Hellen, Charles Wang, Todd Morschel</i>	Maritime 1 & 2
2:40PM	Factors effecting job satisfaction for Mining Surveyors <i>Zac Burley</i>	Maritime 1 & 2
3:05 PM	Close of Conference	Maritime 1 & 2

ABSTRACTS

Wednesday 13 September

Workshop 1 - CR Kennedy - Monitoring Solutions for the life of mine

Presented by Richard Ingham - National Product Manager - Monitoring, Reference stations, HxGN SmartNet Solution



Safety and preservation of life is the number one priority for mine operators. A close second is productivity and maximising revenue. The two are intrinsically linked. Learn how monitoring solutions available through C.R. Kennedy and its partners provide the data required for safe operations and key decision making. Real world insights from customers projects using a variety of measurement technologies. Prism monitoring, GNSS, Wireless mesh networks, Geotechnical sensors, and Lidar, the newest player in this market, we'll provide an update on how this solution is an advantageous addition to your toolbox. Mines today can easily and simply acquire data from a variety of sensors and centralise in configurable software for alerting and long-term trend analysis

Workshop 2 - Trimble/UPG - Trimble Positioning Services and Software for Mining

Presented by David Corcia Sales Manager, APAC Trimble Advanced Positioning

Russell Box, Senior Sales Consultant

Dan Hughes, Sales Consultant

Brent Dawson, Product Manager – Monitoring, Mining, and Tunnelling

Sean Baxter, Technical Consultant - UAV



This session will provide an overview of Trimble Positioning Services (RTX, VRS, Alloy) and how they can benefit the mining industry. The session will also cover new product releases, including hardware and software, as well as an overview of the Trimble Access Mining, Tunnels, and Monitoring modules. A deep dive into monitoring for mining will be presented, looking at the T4D software and showing specific examples. The session will include a demonstration of the latest Trimble Business Centre Software, showcasing its one-stop field-to-finish capabilities with a UAV PPK data set.

This session is intended for mining professionals who are interested in learning more about Trimble Positioning Services and Software.

Workshop 3 - Maptek - Python for Mining Surveyors - An Introductory Workshop

Presented by Ben Connelly - Senior Technical Services Consultant for spatial measurement consulting and training in Australasia



Unlock the potential of the Python programming language and its applications for your mine survey tasks with this workshop. You will gain an introduction to Python and several of its libraries and SDKs, with an emphasis on options designed for the manipulation and creation of spatial data, such as point clouds and triangulations.

The ability to rapidly integrate new tools into existing workflows is critical to success in an evolving digital landscape. This workshop will demonstrate how Python can augment your current processes, enhance efficiency, automate tasks and enable you to create custom solutions to problems that may be outside the scope of existing software.

This session is tailored to provide a basic overview, equipping you with foundational Python knowledge. It will introduce essential terminology and present examples of beneficial Python libraries. Real-world scenarios will be used to demonstrate how Python scripting and libraries can solve complex problems and generate valuable outputs. It will also provide insights into how emerging technologies such as large language AI models can assist in this process.

Join us to discover how you can unlock the power of Python to manage and manipulate mine survey data, and explore possibilities for the future.

Workshop 4 - Position Partners - Applications of autonomous sensor networks for monitoring track and key rail assets

Presented by Anthony Nieves - Business Development Manager - Deformation Monitoring



The application of autonomous sensors to monitor major pieces of infrastructure has been well understood for over 15 years. During this time sensors have become lower powered, easier to install and with more efficient data flows. This has democratised the act of monitoring across a wider range of end-users allowing more time-sensitive and data-supported decisions. This paper will outline the application of sensors in monitoring rail and tunnel infrastructure. In the rail sector, the use of biaxial (now triaxial) sensors to measure lateral trackbed deformation (cant) led to the correlation of longitudinal tilt with manually surveyed settlement. Tilt sensors are now widely deployed in the rail environment negating the need for manual survey and the requirement to have line-of-sight to take an optical measurement.

Workshop 5 - Deswik - Tips and tricks in using Deswik CAD and the point cloud functions

Presented by Stephen Rowles - Product Manager, Survey



Deswik will hold a tips and tricks/masterclass in using Deswik CAD and the point cloud functions broken into the following sections:

- Point cloud processing in Deswik – We will run through a variety of different point cloud examples in both UG and OP environments. You'll see how to use the different filters and editing commands to reduce the density of the scan, remove outliers and get the clouds ready for either surface or solid generation
- Global Constants, Parameter Tables and Formula – Using these functions in CAD, you can streamline the processing of data and make displaying entities on the model space even easier. You'll see a worked example of these in action for a surface and UG operation
- Plotting – Surveyors are known to make the odd plot or two! What features in Deswik can make this simpler, quicker and easier.



Workshop 6 - CR Kennedy - UAV Solutions for the mining industry

Presented by Anthony Boyle - NSW Sales and Support Manger RPAS

Francois du Bois - National Laser Scanning Specialist

Zoot Ngui - Rail, Mining and Geodesy Sales Consultant



Now that the UAV / drone products and solutions have become almost industry standard, C.R. Kennedy has a very wide range of products that will allow you to be able to cover most of your day-to-day tasks.

Mapping products available.

- For long-range mapping the Wingtra PPK VTOL system allows for BVLOS (Beyond Visual Line of Sight) for large scale mapping of the mine site and boundary area.
- For shorter range mapping the new Maverick 3E RTK system is ideal and can be used as a PPK or RTK operation, with 20MP camera and 56x Digital Zoom capabilities.
- Then there is the M300 platform, this is such a versatile product allowing the use of the following add-on technologies to be used, again this can be done with PPK or RTK operation.
- Mapping with a 45MP camera - Bathymetric Surveys / Magnetometer surveys / GPR Surveys / Multi and Hyperspectral Surveys if required / Thermal Imaging for inspections of hot spots etc. / LIDAR, low-mid-high end solutions.

LiDAR products available.

DJI M300 has 2 x LiDAR options with the AA450 and miniVUX-3UAV systems, which give great flexibility to have accurate pointcloud data post processed quickly and easily in a shorter timeframe than conventional mapping. These systems also have imagery if additional mapping is required.

Underground surveying has now become a safer and more efficient way with the ExynAero Level 4 Autonomy drones and LiDAR unit. This allows for dangerous void inspection surveys without anyone getting close to the danger zone, plus one can map almost the entire underground portion of the mine. The drone can fly a path on its own with collision avoidance capabilities.

Mapping / Inspection product available.

Newly released DJI DOC, this allows for a drone to be placed strategically with its own pad, power and communications. This allows the drone to be scheduled for various flight missions whereby it will take off fly its route for either security inspections, general data capture or imagery and or video, the unit will return to the base on its own, and be secure, it will be recharged and the required capture data can be sent back to the office for further analysis or processing.

Mapping Software

PIX4D Mapper / Matic / Survey are powerful tools to process your imagery into the final aligned product and for pointcloud generation as well.

Thursday 14 September

Identifying instabilities early - Slope stability monitoring with InSAR

Jason Pretorius - Manager, SkyGeo Mining Solutions

Jennifer Scoular - Manager, Product

Pieter Bas Leezenberg - CEO

Leo Szewczyk - Senior Data Analyst

As a growing number of geotechnical engineers are learning how to use wide area InSAR as an effective tool for early geotechnical risk assessment, this also opens up new opportunities for surveyors.

This abstract highlights three main areas where surveyors can enhance collaboration with geotechnical and production departments: 1) Verification and validation of this new spatial data set; 2) Carefully extracting relevant deformation signal out of noise from a very large data set; and 3) Optimizing the configuration and deployment of terrestrial instrumentation.

Typically, ground-based instrumentation is limited in its coverage and is placed in areas of active works or where geotechnical risk is already known. To overcome this limitation, wide area InSAR offers a comprehensive view of the entire mine site, enabling surveyors to guide the strategic placement of instrumentation.

This approach is particularly valuable considering that slope failures characterized by meter-scale deformations are often preceded by slower millimeter-scale deformations, which InSAR can effectively monitor. Nevertheless, when sampling displacements at a mine site with millimeter precision, the reality is that everything on the ground is moving continuously. This raises the question: if everything is moving, how do practitioners know which movements are of concern? In this presentation, we demonstrate a multistep process in which we separate geotechnical precursor signals from other ground motion “noise”.

Firstly, we present a case example from a 20 km² mine site in the USA. In November 2022, we detected increasing displacement rates in a specific area of the open pit wall above the entrance to the underground mine. Because this pit wall was not being actively mined, the only ground based monitoring were visual inspections and no cracks had been observed. The mine has two ground-based radars, but these are located in other actively mined pits. Over subsequent months, the observed displacements continued to increase, prompting the site team to relocate a ground-based radar to the slope and implement a remediation plan based on InSAR alerts.

Secondly, at Kansanshi copper mine in Zambia, the 11-day InSAR monitoring service raised an alert in July 2022 indicating an increase in displacement rates on the west slope of the Main Pit. Ground-based radar and robotic total stations did not alert to any anomalous displacements. Subsequent updates unveiled a semi-circular subsidence pattern, indicating a potential precursor to planar failure. Guided by these observations, geotechnical interventions such as horizontal drains and boreholes were implemented for slope dewatering. This proactive approach resulted in a significant reduction in displacement rates, successfully averting a potential slope failure.

Through these case examples, we demonstrate the role of wide area InSAR in early geotechnical risk assessment. By harnessing the power of InSAR, surveyors, in collaboration with geotechnical and production departments, can play an enhanced role in risk mitigation and optimizing mining operations effectively.

Future Demand, Supply and Skills Gap for Surveying and Geospatial Professionals

Michelle Blicavs - CEO of Consulting Surveyors National

The Association of Consulting Surveyors is pleased to provide a full report of the results from the BIS Oxford Economics research into Determining the Future Demand, Supply and Skills Gap for Surveying and Geospatial Professionals: 2022-2032.

Multispectral drone surveys for characterisation of spoil piles

Dr. Simit Raval - School of Minerals and Energy Resources Engineering, University of New South Wales, Sydney

Sureka Thiruchitampalam - School of Minerals and Energy Resources Engineering, University of New South Wales, Sydney

Jason Kolar - Moolarben Coal Operations Pty Ltd, Yancoal.

Elliot Gyler - Mount Arthur Mine, Thiess Pty Ltd.

Aaron Clack - Mount Arthur Mine, Thiess Pty Ltd.

The conventional methods of coal spoil characterisation have relied on field-based observations, which can be risky and time-consuming. Drones have emerged as a cost-effective and efficient method of remotely assessing the landscapes. With advancing technology, drones are becoming more adaptable and functional, leading to increased usage for both recreational and professional applications. This development has led to new prospects for remote sensing using off-the-shelf sensors. This paper presents use of drone imageries and structure from motion (SfM) photogrammetry to automate the process and lessen the time and predisposition associated with manual methods of spoil characterisation.

A DJI Matrice 300 RTK quadcopter was utilized with two payloads (Zenmuse P1 and Altum PT multispectral sensor) to gather RGB and multispectral data over the mine dump sites. The focus of this research is to classify the different types of spoils present in mine dump sites based on the “Coalspoil” framework, using a custom-built automated classification pipeline.

It is observed that the combination of features obtained from RGB data and multispectral data results in the highest overall characterisation accuracy of 92.6% for the coal spoil piles (See Fig). Thematic maps and analysis of these maps can identify dominant spoil categories in the specific layer of dump and assist in making informed decisions on which category of spoils should be deposited to avoid failure.

To conclude, the paper demonstrates a novel and cost-effective approach to characterise coal spoil using drone imageries and structure from motion photogrammetry. Moreover, the study reveals the significance of combining the multispectral data to achieve greater overall accuracy.

From Hydro to Underground. Advice for changing disciplines and why adding a hydrographic surveyor can be beneficial to your team.

Tashka Goswell, MineSurvey Plus

After working in the hydrographic survey industry for 13 years I decided to make the move to mining survey to gain a better work life balance and regain my core surveying skills. I have now worked underground for a year as well as some other surface projects. I will discuss my career path thus far and how I have learnt to challenge my inner imposter syndrome and what transferable skills and perspectives I have brought to my new role.

Overcoming Obstacles: Leveraging Post-Processed Kinematic (PPK) Technology for Rapid Road Corridor Survey in Ecuador

Brenton Stenning - Director GSL Survey, Great Southern Land, Survey Consultants

In January 2020, GSL Survey was engaged to carry out a large-scale photogrammetry project in Ecuador. Due to the heavily treed vegetation a secondary task to carry out a road corridor survey with a specific focus on obtaining an accurate elevation profile was conducted. The project involved addressing numerous challenges and implementing effective strategies to overcome them, ultimately producing reliable results within a minimum time frame.

The presentation emphasizes the utilization of Post-Processed Kinematic (PPK) technology, which played a pivotal role in the entire survey process. It showcases the rigorous testing phase that involved evaluating equipment and techniques, to ensure the highest level of accuracy in data collection. Additionally, the subsequent stages of data processing and assessment of point quality are elucidated, highlighting the critical role PPK played in achieving precision.

Furthermore, the presentation outlines the meticulous field methodology employed during the survey, underscoring the significance of redundancy. The incorporation of static processing is also explained, including the acquisition of control points and CORS data, which significantly contributed to the overall precision of the survey. The presentation culminates in the successful completion of the 145 km road survey within a remarkably short span of two days. Despite the diverse obstacles encountered, the project achieved its objectives, demonstrating the efficacy of the applied PPK technology and the robustness of the implemented methodologies.

History of Mining in Broken Hill

David Hurley - Chief Mining Surveyor & Planner

Include some background on the mining history of the twin as well and the chances you've seen in your time from both a mining methods/equipment point of view and a surveying/engineering point of view.

Scanning Voids 300-500 meters below the surface

David Cox - Specialist, Geotechnical Carrapateena

John Lupton - Director, GeoSight PTY

scanning a cave at Carrapateena 500m below surface. This involved DGRT to supply the wireline and winch while GeoSight supplied a modified CMS and booms. A 500m long hole was drilled and cased. The void is 150m X 150m X 150m and filled with vapours.

GeoSight also developed a CALS scanner (GSM-16) that can operate 300m below the surface. The GSM-16 uses 4 Mems Gyros and Dead Reckoning while recording video of the hole and void.

GeoSight has also leveraged the same Mems Gyro PCB into an accurate and inexpensive drill hole deviation tool (SCOUT).

Facing the challenges of Surveying education

Dr Craig Roberts - Senior lecturer in Surveying, GPS + Geodesy, University of New South Wales

Dr Craig Roberts will discuss a new 25hr iSTEM curriculum that he has developed with the NSW Education Dept and promises to be a powerful new form of marketing. He will announce the new pathway that UNSW have created for articulation for TAFE Diploma Surveying and Diploma Spatial students into our BE(Surveying) degree program at UNSW. This has been in hiatus for almost a decade. Finally, he will discuss an innovative new funding arrangement to address succession planning concerns within the BE(Surveying) program within the School of Civil and Environmental Engineering.

Mines and Pubs and their historical importance in society

Ed Tonks, Mining Historian

The connection between mines and hotels and their importance in society from a Hunter Valley perspective.

Highwall Mapping with P4 RTK Drone

Brendan Nichols, Hunter Valley Operations

Presentation on alternative method for Highwall mapping using a Phantom 4 RTK Drone. Presentation to include:

- Overview of Hunter Valley Operation Mine, Survey team and equipment used.
 - Reason for adopting this method, benefits identified to using P4 RTK Drone for mapping over Maptek XR3 Scanner.
 - Process in the field adopted at HVO for mapping Highwalls using P4 RTK Drone. This will include identifying set up locations, best flight paths, offset from Highwall, hazards to be mindful of as well as detailing the full mission planning process.
 - Procedure for processing data in Pix4D and Maptek Point Studio.
 - Overview of output and checks completed.
 - Aim to include video in the presentation to illustrate flight method, quality of output in comparison to traditional scanner output.
 - Benefits to this process include:
 - Ability to map HW's that are not accessible with traditional scanners.
 - Higher level of detail in data sets using a textured mesh output allowing more accurate identification of HW structures (Joints, Seams, dykes etc).
 - Quicker process in comparison to using traditional scanner on legs.
 - Quicker process for Geotechnical team to digitise structures.
 - Smaller output file size.
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Shaping of mine overburden for natural landform rehabilitation at Mangoola Coal

Ricki Clifford - Senior Mining Engineer, Glencore - Mangoola

Shaping of mine overburden for natural landform rehabilitation at Mangoola Coal, a 13 year journey.

This presentation will summarise why we changed, who was involved, what methods we have developed and show the outcome of all the energy spent.

Promotion of Surveying Careers in NSW

Cathy Moses, NSW Surveying Taskforce Manager

With the ongoing challenge of the skills shortage in surveying, the Surveying Careers Taskforce is actively working with local schools to promote a career in surveying. Cathy Moses will present on recent activity, including a partnership with the Minerals Council, the NSW Department of Education and expansion of the Maths in Surveying program. AIMS has been a partner in the Taskforce for many years and we need more members involved to spread the words to encourage students to choose a career in surveying.

Target Resolution: Practicability for Terrestrial Laser Scanning (TLS) Resolution

Mansoor Sabzali - Civil, Surveying and Environmental Engineering, University of Newcastle, New South Wales

Lloyd Pilgrim (Corresponding Author) - Civil, Surveying and Environmental Engineering, University of Newcastle, New South Wales

Terrestrial laser scanning (TLS) is a terrestrial LIDAR (light detection and ranging) which is categorised as the active electro-optic (EO) sensor. LIDAR and LADAR (laser detection and ranging) are two prominent products of EO systems. LADAR or laser radar is the combination of laser and radar which operates in the optical frequency (shorter wavelength in the domain of visible to infrared of electromagnetic wave (EM)), rather than conventional radar using the microwave frequency (higher wavelength), and it has its own active illumination source. Here, we borrow the fundamental concept of LADAR to respond to unanswered question of TLS resolution. Resolution in essence means the distance between two adjacent points. It must not be mistaken with accuracy and precision. Spatial resolution of TLS is divided into range and angular resolution. On the other hand, target resolution of LADAR is its ability to distinguish between two or more close targets in either same range or bearing. Range resolution is to observe between targets on the same bearing but at different ranges, whereas bearing (azimuth) resolution is to separate objects at the same range but at different bearings. This research will investigate the range and bearing resolution of TLS via reliance on target resolution of LADAR. This can be achieved as the result of simple laboratory configuration of scanning regardless of the other systematic errors of TLS. The resolution experiment was tested on Leica ScanStation P50 whose range accuracy and beamwidth are 1.2 mm+10 ppm over the full range and ≤ 3.5 mm (full width at half maximum (FWHM)), respectively, as reported by Leica Geosystem. The comparison of the calibration specifications mentioned by manufacturer with our findings is the objective of this research.

Evaluation of Australian-made GNSS-IoT Sensor Performance in EDM Calibration Site and Waste Landfill Site

Jun Wang - Head of Research, Kurloo Technology

Lee Hellen - CEO / Co Founder, Kurloo Technology

Charles Wang - Head of Hardware Product, Kurloo Technology

Todd Morschel - General Manager Operations, Kurloo Technology

Kurloo is a Global Navigation Satellite System (GNSS) sensor with low-power wireless connection and cloud-based analytics capable of providing near-real-time surface displacement measurements at 3-millimetre precision. It was invented and developed in a 3.5-year \$4.5 million collaborative research project between Brisbane-based surveying and structure-health-monitoring company Monitum, QUT, Innovative Manufacturing Cooperative Research Centre (IMCRC), and local manufacturer Intellidesign. The Kurloo devices are low power, built-in solar panel, high position, and can transmit data as remotely controlled from the cloud server. It is portable, low cost, easy to install. By providing daily precise and accurate measurement Kurloo can help customers and stakeholders improve productivity, increase return on investment (ROI), and manage risks around environments, buildings, and structure.

To evaluate the proposed system performance, two experiments were carried out at an Electronic Distance Measurement (EDM) Baseline Calibration Site and waste dump facility, which demonstrate that 3-millimetre positioning result is achievable, and the advantages of continuous monitoring outperform the traditional surveying method. The EDM calibration site length proficiency testing was carried out with two independent sessions by compared to Leica TS60 total station. 5 out of 6 baselines have passed the traceability testing, the failed baseline of which is due to the bad GNSS observation condition. Settlement of waste dump is a long term and complex process. The settlement monitoring of landfill bodies plays a significant role in the reclamation of the landfill and aftercare following its completion and it is crucial to evaluate the volume of the landfill body. After consulting with geotechnical engineers and inspecting the waste landfill area, two sensors have been deployed in the site since 5 March 2021 and ongoing. In this waste dump landfilling experiment, Kurloo positioning results have demonstrated the benefits with respect to accuracy, cost, efficiency and safety (ACES). Within the two extensive performance evaluations, it is shown that an Australian-made GNSS-IoT Sensor exists to solve complex engineering problems more economically and accessibly.

Factors effecting job satisfifaction for Mining Surveyors

Zac Burley, Registered Mining Surveyor

Outcome of recent research into factors affecting job satisfifaction and retention of Mining Surveyors and what could be done to prevent mine surveyors from changing roles, by linking and defining the common themes to answer the question are Mine Surveyors satisfied in their role and does this Impact Role Retention?