Mining Surveying Workshop

Saturday 10 September 2022
Conference Centre DoubleTree by Hilton, Warsaw, Poland

PROGRAMME

9:00-9:30	Welcome and Opening Remarks Prof. Ryszard Hejmanowski (AGH UST)
9:30-10:15	Mobile mining platform - Application in the precise acquisition of 3D data in mining works ***A. Adamek*** *(Skala 3D Ltd.)*
10:30-10:45	Coffee break
10:45- 11:30	The use of 3D laser scanning techniques in an underground coal mine. The example of LW "Bogdanka" S.A. ***M. Sorkowski*** *(LW Bogdanka S.A.)*
11:45- 13:00	Lunch break
13:00-13:45	Laser scanning technology as the modern way of data acquisition based on selected jobs completed in KGHM Polska Miedź S.A. ***J. Kukuła,*** *W. Kumosiński (KGHM PM S.A. O/ZG Lubin)*
14:00- 14:45	Comprehensive Method of Assessing the Flood Threat of Artificially Drained Mine Subsidence Areas for Identification and Sustainable Repair of Mining Damage to The Aquatic Environment ***D. Ignacy*** *(GIG Research Institute)*
15:00-15:15	Coffee break
15:15-16:00	New trends in InSAR technologies and analyses for mining areas ***U. Wegmüller,*** *C. Magnard, C. Werner, S. Leinss (Gamma Remote Sensing AG)*
16:15- 17:00	Underground measurements of hard-to-reach spaces with a special inspection system (drons) ***W. Stolarski*** *(Geotronics Ltd.)*
17:15-17:30	Closing Remarks *Prof. Ryszard Hejmanowski*
	Dinner

The presentations are to be followed by 15 minutes of discussion

Organizers

FIG Commission Engineering Surveys

Faculty of Mining Surveying and Environmental Engineering of the AGH University of Science and Technology

Faculty of Mining, Safety Engineering, and Industrial Automation of the Silesian University of Technology

Department of Geology, Geophysics and Environmental Protection of Central Mining Institute

International Society for Mine Surveying

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Mining Surveying Workshop

ABSTRACTS

Artur Adamek (Skala 3D)

Mobile Mining Platform - Application in The Precise Acquisition of 3D Data in Mining Workings

The presentation concerns the use of a multisensory measurement platform to test the geometry of mining shafts and all elements of the installed infrastructure. This platform is also adapted to work in horizontal workings. It is based on laser profiling scanners and a panoramic scanner as well as precision microscanners and a video camera. All sensors are connected to the control computer. The trajectory is determined by a precise inertial unit (IMU) which allows you to determine the route of the platform being moved. Measurements carried out in many shafts confirmed the very high quality of the 3D product obtained by measuring, with a precision within 1 to 5 mm. The platform has implemented proprietary software that integrates and analyses all data and allows for online viewing. The platform shortens the measurements in the shaft to a maximum of several - several hours, at least twice as fast as traditional methods.

Mieszko Sorkowski (LW Bogdanka S.A.)

The Use Of 3D Laser Scanning Techniques in an Underground Coal Mine on The Example of LW "Bogdanka" S.A.

Lubelski Węgiel "Bogdanka" S.A. is one of the leading producers of hard coal in Poland in terms of financial results, efficiency of hard coal extraction and investment outlays. Under Polish conditions, hard coal is exploited through underground mines with a mining depth of up to 1000m underground. The wide range of exploitation works the global situation on the hard coal market and the increasing financial burden on the mining industry resulting from the tightening of the environmental protection policy require the use of innovative solutions in the production process. One of the innovative issues in Polish conditions is the use of laser scanning. In our plant, we use measurement systems based on handheld scanners, a stationary scanner and the use of dedicated mobile platforms for scanning teams. A special aspect of these activities is the monitoring of vertical workings of shaft pipes, hoisting devices and the technical infrastructure built in them. In the few vertical workings connecting the pavement system with the surface, it is very important to reduce the time-consuming measurement activities due to the necessity of their continuous operation. The obtained measurement data in the form of point clouds are transferred to the departments involved in the design of the excavation network and the selection of the type of support and its spacing. The necessity to move large elements or entire mining machines in the limited space of the mine workings network causes many difficulties. 3D modeling of logistic routes significantly facilitates the identification of problematic fragments of "bottlenecks" and enables the selection of the best route or indicates the scope of necessary works to unblock them. Scanning on a smaller scale can be used to check the correctness of the execution of the ordered housing elements. In practice, most of the measurement tasks performed in this technology are repeatable and focus on capturing the differences between successive measurement periods. The scan itself must be based on an accurately calculated measurement matrix, which in the conditions of underground mining and somewhat assumed displacements of

the flexible arch support is a challenge in itself. The experience gained as a result of the measurement and calculation activities carried out results in the development of more perfect procedures and obtaining greater accuracy of measurement. To sum up, the scanning technology in the conditions of underground mining is a very important component in the process of quick collection of information that has a direct impact on the safety of the current and planning subsequent mining activities. Combined with advanced techniques for further processing of the obtained data, it is an integral part of the process of improving the method of production management.

Jacek Kukuła, Wiktor Kumosiński (KGHM PM S.A. O/ZG Lubin)

Laser Scanning Technology as The Modern Way of Data Acquisition Based on Selected Jobs Completed in KGHM Polska Miedź S.A.

Survey Department of KGHM P.M. SA O/ZG „Lubin" has used the laser scanning technology since 2012. To date, we realized a lot of tasks, where laser scanner was the optimal solution. There were various objects of mining infrastructure which we measured using laser scanning technology. Collected data let us make some analysis, calculations or 3D models. Throughout years of our laser scanning usage, we cooperated with many departments in our company. Thanks to obtaining high precision data we were able to deliver them satisfying results. Big advantage is the possibility to take measurements directly on point clouds. It allows us to save time and duration of underground work. That has to do with occupation health increase. This presentation shows the results of interesting tasks realized by employees of KGHM P.M. SA O/ZG „Lubin" Survey Department.

Dariusz Ignacy (GIG Research Institute)

Comprehensive Method of Assessing the Flood Threat of Artificially Drained Mine Subsidence Areas for Identification and Sustainable Repair of Mining Damage to The Aquatic Environment

The effects of mining, apart from surface subsidences and deformations, are forced flows of surface and underground waters, lasting many decades in the mining areas. Natural water flows should be restored by mining entities and/or their legal successors in the process of the mine closures. Such action is tantamount to a restoration of the previous state in the sense of repair of damage to the environment and surface infrastructure. Then, under natural water flows conditions, such mining areas may become flooded, often quite extensively. We describe a comprehensive method for flood threat assessment of artificially drained mining and post-mining areas after the restoration of natural water flows. The term mine subsidence area (MSA) is defined as that part of the rock mass containing solid mineral deposits and the above surface affected by continuous and non-countinuous deformation (as currently legally defined in terms of range and intensity). This method, together with simultaneous measurements of water levels at outflow places at the MSA boundary allows for useful way of mapping the MSA surface. This has been developed to fully identify the true extent of mining-induced damage to the MSA aquatic environment. It introduces innovative hydromorphological elements of the MSA. These allow zoning of the MSA surface while taking into consideration future drainage works and/or projected mining subsidences inside the MSA. These spatial hydromorphological maps of the MSA identify the framework of permanent and occasional flooding and constitute the final result of this method. It is a universal tool for sustainable water management and quantitative evaluation for extraction of minerals.

Urs Wegmüller, Christophe Magnard, Charles Werner, and Silvan Leinss (Gamma Remote Sensing AG)

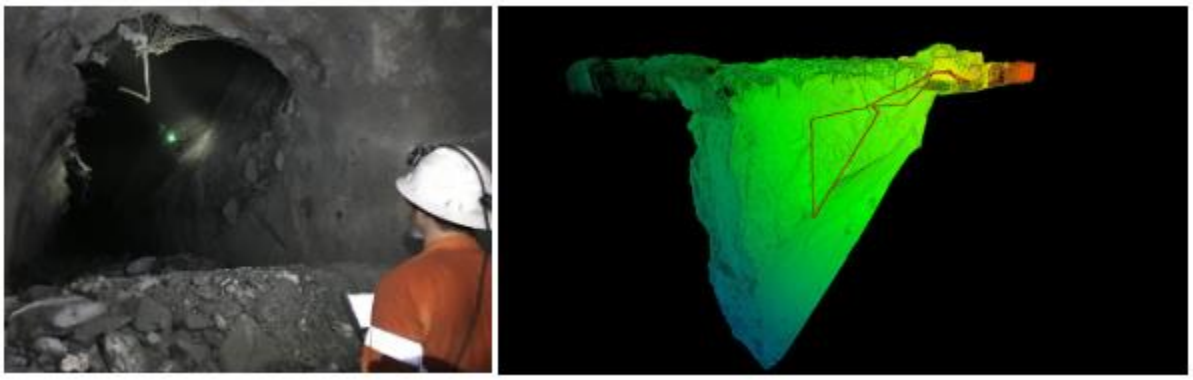
New Trends in InSAR Technologies and Analyses for Mining Areas

Mapping ground motion in mining areas with satellite InSAR started before the year 2000. Since then, the methods have consolidated, more and better suited sensors are available. In addition, terrestrial radars have become available. The mining case is one of the more challenging InSAR applications. Displacements can be fast, non-uniform and with large spatial gradients. The steep walls of open-pit mines can be problematic for the satellite SAR imaging geometry. The applicability of the technique and its potential improved in recent years thanks to newer existing and planned satellites that offer consistent acquisitions at shorter time intervals and higher spatial resolution. Furthermore, terrestrial radars are an important additional tool. Terrestrial radars are better suited to monitor steep walls and have an extremely high flexibility in the selection of the view direction and the monitoring interval. Furthermore, there is no dependence on satellites and the data the real-time capability permits setting up alert systems. Strengths and weaknesses of satellite and terrestrial InSAR for the mining application and the potential of new and planned systems will be discussed.

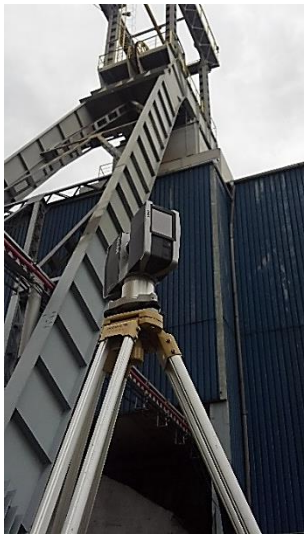
Wojciech Stolarski (Geotronics Ltd.)

Underground Measurements of Hard-to-reach Spaces with a Special Inspection System (drons)

During the workshop, an autonomous and versatile system for quick and precise acquisition of three-dimensional data in the form of point clouds using the Emesent Hovermap mobile scanner will be presented. Systems of this type are dedicated and are used in places with difficult access or where human access is associated with a high risk to his health and life, e.g., underground mines. The proposed solution can be used in various variants, making it a universal tool that can be used in fast mobile mapping enabling mapping, for example, of underground workings and corridors, shafts and underground voids. The system can work on many mobile platforms, e.g., vehicles or drones, based on the autonomous navigation of the flying platform based on the point cloud obtained on an ongoing basis during operation.



The system is based on Emesent Hovermap - a mobile laser scanner operating in SLAM (Simultaneous Localization And Mapping) technology with the option of installation on the Matrice 300 drone, taking control of the control and navigation based on the currently acquired point cloud. The point cloud, thanks to the SLAM technology, is assembled on an ongoing basis during the scanner movement and combined into a coherent, precise 3D model. The result of the study is a point cloud, which is a 3D representation of the measured object. On this basis, we obtain precise information about the shape of the tested object. By integrating the measurement with the marked reference points, we also obtain the location of the point cloud in any reference system. From the point cloud, we can read the coordinate of each point, measure between any elements, create cross-sections, analyze losses or compare object deformations over time or in relation to the theoretical model. The Trimble RealWorks program will be used to visualize and develop the measurement. The accuracy of the solution can reach the level of 1-2 cm. As determinants of the measure of accuracy, one can use control points or multiple measurements to compare the course of the resulting point clouds. However, the real advantage of this method is the amount of data (range), efficiency and the ability to perform measurements in hard-to-reach places.



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The Foundation for the Faculty of Mining, Safety Engineering, and Industrial Automation of the Silesian University of Technology

The Foundation for the Faculty of Mining, Safety Engineering, and Industrial Automation of the Silesian University of Technology was established in 2017. The Silesian University of Technology in Gliwice is the oldest technical university in Upper Silesia and one of the largest in Poland. It was established after World War II in 1945 as a research and teaching base for the most industrialized district in Poland - Upper Silesia. In 2020, the university celebrated its 75th anniversary. For many years now, due to the wide didactic offer and high quality of education, the Silesian University of Technology has been one of the leading Polish technical universities, which is confirmed by its high positions in rankings of higher education institutions. It is currently one of 10 universities awarded in the competition "Initiative of Excellence - Research University" by the Ministry of Science and Higher Education. The Silesian University of Technology currently educates over 18 000 students and offer more than 50 study programs and about 200 specializations, including the whole spectrum of engineering studies within 13 faculties and two institutes. The education is conducted, among others, in the field of Geodesy and Cartography. One of the faculties is the Faculty of Mining, Safety Engineering, and Industrial Automation. The Faculty was established in 1950 as the Mining Faculty of the Silesian University of Technology in response to the demand for engineering staff for Silesian coal mines. On August 31, 1950, the recruitment for the first year of engineering studies in the specialties of mining of deposits and processing of solid minerals was completed. In the following years, education began in a wide range of specializations, including mining surveying. In 1991, the Faculty adopted the name of the Faculty of Mining and Geology, and in 2019, after its restructuring carried out under the leadership of the current Dean, Prof. dr. hab. Eng. Franciszek Plewa, the Faculty took the name of the Faculty of Mining, Safety Engineering and Industrial Automation. Currently, the Faculty has five Departments. At the Faculty, students are educated in five fields of study. Among others, in the field of Geoengineering and Raw Materials Exploitation.

The Faculty of Mining, Safety Engineering, and Industrial Automation of the Silesian University of Technology

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