The SME Pittsburgh Section is offering the Third Annual Spring Seminar Series. This year, the Series consists of seven, 120-minute virtual sessions beginning on Tuesday, May 21st and continuing thereafter on a Tuesday/Thursday schedule for 3.5 weeks (May 21, 23, 28, 30, June 4, 6, and 11). All Seminars will begin at 1:00 PM EDT and will conclude at 3:00 PM. During each session, a total of 6 papers will be presented at 20-minute intervals.

The Seminar Series is offered for free and PDH certificates will be available at 2.0 hrs/session or a total of 14 hrs for the complete series at a cost of $75. Attendees must register for each Seminar AND separately for PDHs if desired.
Tuesday, May 21, 2024 - Technology in Mining/Maintenance  
Session Chair – Jim Zhou, NIOSH

12:45 PM - Open the Zoom Meeting Seminar (Authors Only)

1:00 PM Opening Remarks

1:05 PM - Mine Wireless Systems: Interference Risks and Regulatory Implications
by Carl Sunderman, PE, NIOSH, Spokane Mining Research Division, Email: cps5@cdc.gov

Abstract: Wireless communication systems are critical infrastructure for the modern digital mine. These systems support operational efficiency and safety in many domains such as emergency voice communication, automation, sensing, control and personnel and asset tracking among others. It is often assumed that current regulations will ensure that these systems will operate interference free, thus providing mine operators a level of protection from their equipment being interfered with and/or liability for interfering with others, however that is not always the case. This study first clarifies the Federal Communication Commission rules governing operation of wireless communication systems at mine sites in the United States. It then goes on to identify several classes of wireless communication equipment. For each class both the degree of protection against outside interference and the potential liability for generation of interference to others is discussed. And finally, it discusses the implications for mine wireless operators and identifies some potential ways to lessen interference risk.

1:20 PM - An Overview of NIOSH Safety and Health Research on Robotics and Automation in the Mining Industry
by Jacob Carr, PhD, NIOSH, Pittsburgh Mining Division, Email: JCarr1@cdc.gov

Abstract: This paper will provide an overview of research conducted by the National Institute for Occupational Safety and Health (NIOSH) in the area of robotics and automation in the mining industry. This includes intramural research at the NIOSH Pittsburgh Mining Research Division and Spokane Mining Research Division as well as research funded extramurally through contracts and grants. Relevant non-mining research from elsewhere in NIOSH will also be presented along with partnerships and cooperative relationships. Topics that will be discussed include robotics for mine escape and rescue, assured autonomy considerations for mining equipment, supporting technologies, and human-centered design for automation in mining.

1:40 PM - Safety Pays in Mining Version 2.0 - Demonstrating the Financial Impact of Injuries in Mining
by John R. Heberger, NIOSH, Pittsburgh Mining Division, Email: jheberger@cdc.gov

Abstract: The NIOSH Mining Program has updated that data used for the Safety Pays in Mining v2.0 web application, which helps mines determine the potential costs
associated with mining injuries and the distribution of these costs. This web application groups injuries by severity (medical only or lost-time injury cases) and then by injury cause, part of body injured, nature of injury, as well as combinations of each. When the user selects one of over 150 common mining injuries, the application provides the distribution of medical and indemnity costs of workers' compensation claims for that type of injury. Based on other user inputs, the web app will estimate the total costs of the selected injuries, including an estimate of additional indirect costs, and the impact of total injury costs on mining company profits. This presentation reviews the Safety Pays in Mining v2.0 web application by discussing the updates, how it is used to show the true costs of mining injuries, and how mines can benefit from using this application.

2:00 PM - Perceptive Track Projection – Creating Context Sensitive Path, Velocity, and Auxiliary Activity Projections for Use in Autonomous Safety Intervention Systems by Robert Bissonette PE, NIOSH, Spokane Mining Research Division, Email: RBisonette@CDC.gov

Abstract: Machine Situational Awareness (MSA) requires the ability to efficiently evaluate probability of interaction of objects within its environment without creating false alarms or ignoring materializing hazards. To do that, an MSA system needs to assign context to object motions it observes and integrate as much information about object identity, kinematics, behavior, and current activity as possible. This paper describes how known object characteristics, behaviors, and activities (drilling, dumping, driving, etc.) can refine interaction probabilities and help identify rogue actors that introduce anomalous risks to health and safety of miners. Path projections need to incorporate velocity and direction as a function of time while accounting for terrain, safety response, environmental factors, current assigned activity, etc. This paper also describes methodology for properly prioritizing responses to put highest value on human safety.

2:20 PM - Ground Truth Instrument Testing for Evaluating Collision Warning and Avoidance Systems (CXS) Designed for Haul Trucks by Chenming Zhou, PhD, NIOSH, Pittsburgh Mining Division, Email: czhou@cdc.gov

Abstract: Between 2005 and 2021, surface mining haul trucks were involved in 54 fatal incidents in the United States. Collision warning and avoidance systems (CXS) can help haul truck operators navigate their route safely. The evaluation of CXS object detection performance for surface mining haul trucks relies on the positional accuracy of the ground truth instrument. As part of a holistic approach, researchers from the National Institute for Occupational Safety and Health (NIOSH) characterized the accuracy of a global navigation satellite system (GNSS) that serves as the ground truth instrument to determine object position and velocity in CXS object detection performance testing. We used precision surveying equipment to establish ground truth points for comparison with GNSS data collected for static positional measurements and reduced-scale straight line vehicle dynamic tests. We conducted these tests with real-time kinematics (RTK) and then satellite-based augmentation systems (SBAS). For the dynamic tests, we measured a distance error of 1.34"m (4.40"ft) using RTK and 1.50"m (4.92"ft) using an SBAS. List
research will provide CXS manufacturers and CXS researchers a basis for evaluating the positional accuracy of CXS. Note that we did not evaluate any CXS in this experiment.

2:40 PM - Mine Maintenance and Repair by Ralph R. Sacrison, Sacrison Engineering, Email: rsacrison@frontiernet.net

Abstract: A brief presentation developed from Chapter 28 of the 2023 SME Underground Mining Handbook. Taking an organized and systematic approach to identifying and accomplishing work is fundamental to success in mine maintenance. Today’s challenges are numerous and include factors like the increasing remoteness of new mine locations, turnover of workforce to retirement and departure to other industries, continual competition for talent, and advancing automation of machines and growing complexity of associated tasks. Success in meeting business goals is greatly enabled by the maintenance team’s responsiveness to and alignment with mine operations. Opportunities to improve the team’s maintenance approach may take many forms, but they all rely on the regular collection and review of equipment performance data to drive ongoing learning. There can be much to gain from trialing and adopting techniques thought of as best practices to create solutions for improving asset reliability and ensuring the safe completion of daily maintenance tasks. Selected maintenance concepts and methods are presented, from across mining and multiple other industries. The more detailed discussions presented in the Handbook include specific sections on mobile and stationary equipment. The viewer is encouraged to consider and practice those concepts to the success of their work.

2:55 PM - Closing Remarks

3:00 PM – Session Closed – Next Webinar: Thursday May 23, 2024
12:45 PM - Open the Zoom Meeting Seminar (Authors Only)

1:00 PM Opening Remarks

1:05 PM - An Integrated Method to Classify Ground-fall Accidents and to Estimate Ground-fall Trends in U.S. Mines Using Machine Learning Algorithms by Gamal Rashed, PhD, NIOSH, Pittsburgh Mining Research Division, Email: mqx3@cdc.gov

Abstract: Ground falls in U.S. underground coal mines can lead to significant consequences, including loss of life, injuries, damaged equipment, and production stoppage. Improving the safety of the workplace is of utmost importance for mine workers and the U.S. economy. The Mine Safety and Health Administration (MSHA) accident/injury/illness dataset provides short narratives for reported incidents, including ground-falls. The main objective of this study is to develop a framework that includes: 1) utilizing machine learning algorithms to categorize ground-fall incidents from narratives based on the main cause of the occurrence and 2) demonstrating an example of a user-friendly visualization to display injury/fatality trends from narratives in U.S. coal mines between 1983 and 2021. The developed framework was tested on a subset of the data and achieved an average F1-score of 96% in categorizing the incidents. The outcome will help identify areas requiring additional research and innovative solutions to reduce severe occupational hazards.

1:20 - Examining Pull-Out Tests for Grouted Rib Bolts: A Comprehensive Analysis by Khaled Morsy Mohamed, PhD, NIOSH, Pittsburgh Mining Research Division, Email: kmy1@cdc.gov

Abstract: Resin-grouted bolts serve as a crucial means of stabilizing yielded coal ribs in underground coal mines. A comprehensive investigation into their efficacy was undertaken by a collaborative effort between the National Institute for Occupational Safety and Health (NIOSH) and Missouri University of Science and Technology (MST). This study involved pull-out tests in multiple locations, including six coal mines and the NIOSH research mine. A total of seventy-three (73) tests were conducted, of wide range of anchorage lengths, ranging from a short encapsulation length of 0.305 m to a fully grouted encapsulation length of 1.524 m. The test findings indicate that when short encapsulation bolts are installed at high rotation speeds, their anchorage capacity is significantly reduced, leading to failure at the bolt-grout interface. Conversely, when these bolts are installed at lower rotation speeds, they exhibit greater capacity, with failure occurring at a higher anchorage load equivalent to the yield load of steel rebar. No matter what the rotational speeds were used during bolt installation in this study, the fully grouted bolts consistently experienced failure at the ultimate load of the steel rebar. Most of the tests
carried out on partially grouted bolts with anchorage lengths of 0.610 - 0.914 m have shown behavior patterns like the fully grouted bolts, although exhibiting reduced stiffness. The outcomes of this research offer a profound insight into the ways in which resin-grouted bolts enhance the stability of coal mine ribs.

1:40 PM - Bridging the Gap: Translating Geologic Assessments into Mining Practices by Mark Van Dyke, NIOSH, Pittsburgh Mining Division, Email: mvandyke@cdc.gov

Abstract: Attempts throughout the history of mining have tried to link geology to optimal roof support systems. This presentation will cover methods of collecting geologic data and cases of discovered geologic anomalies that lead to usable information for engineers to design effective support designs when geologic transitions in the roof occur in coal mining. Sound engineering solutions in response to geologic anomalies starts with geologic data collection from sources such as corehole drilling, electronic log interpretations, video scope observations, and rock testing data. Within the geologic observations certain conditions must be described such as bedding thicknesses, inclusions, and geologic contact changes that could affect the interpreted strength of the rock body. From the interpreted geologic description a geologic model can be produced to determine where the geologic anomalies could trend throughout the projected mine plan. Geomechanical engineers must determine the appropriate support for the mine entry based on many factors such as the availability, ease of installation of standing supports, length, and diameter of roof bolts, and the best spacing between these supports based on the geologic assessment and the overall strength of the rock mass. The presentation will cover 3 cases of discovered geologic anomalies and what the engineering solutions were to help overcome the obstacles to provide the best engineering support design to ensure mine entries are safe and promote worker safety and health.

2:00 PM - A Study on the Impact of In-Seam Rock Partings on Coal Pillar Strength Based on Field Instrumentation and Numerical Modeling at the Maple Eagle Mine by Morgan Sears, NIOSH, Pittsburgh Mining Division, Email: krt2@cdc.gov

Abstract: Researchers at the National Institute for Occupational Safety and Health are examining the impact of in-seam rock partings on coal pillar strength to determine an optimal virtual mining height for current stability analysis tools. Utilizing the boundary element model LaModel, data from Maple Eagle Mine in Southern West Virginia was analyzed, focusing on abutment stresses and pillar performance measured through borehole pressure cells and extensometers at three sites. This study calibrated LaModel to match the Bieniawski pillar stress gradient, adjusting the modeled mining height to reflect field observations of slabbed leave pillars. The findings suggest a 52% reduction in shale parting thickness (excluding clay layers) is viable, validating the ARMPS/ACPS "50% Rule" for this mine, providing a significant insight that could influence future research.
2:20 PM - Using S-Pillar in Underground Stone Mine Pillar Design: Understanding Limitations by Gamal Rashed, PhD, NIOSH, Pittsburgh Mining Research Division, Email: mqx3@cdc.gov

Abstract: The S-Pillar software is a tool that NIOSH developed to design stone pillars based on guidelines published in 2009. S-Pillar is one step ahead of most of the current empirical pillar strength equations because it accounts for the effect of geological discontinuities on stone pillar stability; however, it has some limitations. Some of the main limitations in S-Pillar are: 1) the depth limitation, the depth of cover in 90% of the S-pillar database is 600 ft or less and using S-Pillar at deep cover areas is not recommended; 2) the multilevel mining limitation, S-Pillar was generated for single-level mines and does not account for the stress transfer due to an interaction between mining levels. Therefore, the critical interburden thickness to isolate mining levels needs to be determined such that S-Pillar could be used; 3) the shape limitation, S-Pillar does not account for irregular or diamond shape pillars; 4) multiple discontinuity limitations, S-Pillar accounts for only one set of large discontinuities. However, the rock mass may include more than one set of these discontinuities; 5) the weak band limitation, S-Pillar does not account for the impact of weak clay or calcite bands in stone pillars, the extrusion of weak bands can induce tension which prompt failure at much lower stress; 6) the dip limitation, the strength of stone pillar decreases with increasing the seam inclination, the S-Pillar strength equation does not account for the effect dip on stone pillar stability. These limitations are inherent in the S-Pillar database and its strength equation. Understanding these limitations is important to achieve stability in stone pillar design reducing the potential for adverse ground conditions and pillar failures.

2:40 PM - A Study of the Key Factors Associated with a Massive Pillar Failure in an Underground Limestone Mine using Numerical Models by Gamal Rashed, PhD, NIOSH, Pittsburgh Mining Research Division, Email: mqx3@cdc.gov

Abstract: Several massive ground collapses occurred in the past decade in US underground stone mines where surface subsidence occurred in most of them. The occurrence of a massive ground collapse in stone mines places the mine workers at great risk. The National Institute for Occupational Safety and Health (NIOSH) initiated a project to better understand the causes of these massive collapses and reduce/eliminate their future occurrence. Previously the authors investigated one of these massive collapses and it was found that pillar failure was the most likely cause for the collapse. In this study, the authors further investigated the impact of pillar benching, karst cavities, and geological discontinuities on the potential for pillar failure. 3D LiDAR scans were utilized to determine the extent, location, and dimensions of the karst cavities. Stress and deformation analysis were conducted using 3DEC models to gain more insight about the impact of floor benching and poor rock mass quality on stone pillar stability. Poor rock mass quality can be attributed to the existence of karst cavities, small joint spacing, and poor joint conditions at the study mine. Based on the numerical modeling results, floor benching in association with linear karst cavity and geological discontinuities in pillars can
create a large uncontrolled displacement, sliding along pre-existing joints, and induce
tensile stresses near the center of the pillar that may result in a brittle pillar failure.

2:55 PM - Closing Remarks

3:00 PM – Session Closed – Next Webinar: Thursday May 28, 2024
12:45 PM - Open the Zoom Meeting Seminar (Authors Only)

1:00 PM Opening Remarks

1:05 PM - Update on Environmental Susceptibility of Mine Utility Vehicle Lithium-ion Battery Research by Dave Yantek, NIOSH, Pittsburgh Mining Research Division, Email: mqx3@cdc.gov

Abstract: NIOSH PMRD is conducting research to determine the operating environment for mine utility vehicles and rubber-tired mantrip lithium-ion batteries. This presentation will provide a brief overview of the project along with an update on field testing preparation. In addition, in-house vibration data collected on NIOSH PMRD's mine utility vehicle test track will be discussed.

1:20 PM - Explosion-Proof Enclosure Failure to Contain a Lithium-Ion Battery Thermal Runaway by Thomas Dubaniewicz, NIOSH, Pittsburgh Mining Division, Email: tcd5@cdc.gov

Abstract: Gassy underground mines commonly use explosion-proof (XP) enclosures to enclose electrical ignition sources to prevent propagation of an internal methane-air explosion to a surrounding explosive atmosphere. Researchers at the National Institute for Occupational Safety and Health (NIOSH) conducted a lithium-ion battery thermal runaway test within a modified MSHA-approved XP enclosure to assess thermal runaway containment. Thermal runaway produced jet flames emanating from the cover joint at several locations and distorted the cover joint and bottom plate of the enclosure beyond allowable limits. The test demonstrates that XP enclosures may not provide adequate explosion protection against lithium-ion battery thermal runaway. This presentation suggests some approaches to mitigate the hazard.

1:40 PM - Evaluation of Different Suppression Techniques for Lithium-Ion Battery Fires by Liming Yuan, PhD, NIOSH, Pittsburgh Mining Division, Email: lcy6@cdc.gov

Abstract: Lithium-ion (Li-ion) batteries are finding more use as power sources in the mining industry. However, they are known to pose significant fire and explosion hazards. When a Li-ion battery is exposed to excessive operating conditions, its internal temperature may exceed a normal operating range, allowing the active component materials to decompose or react with each other, eventually leading to thermal runaway. A Li-ion battery contains certain oxidizing agents making suppression of a battery fire very challenging. A series of Li-ion battery fire suppression tests were conducted by researchers at the National Institute for Occupational Safety and Health (NIOSH) to evaluate the effectiveness of different fire suppression test systems including dry
chemical, water spray/mist, and Class D extinguisher powder. The batteries tested are commercial nickel manganese cobalt (NMC) and lithium iron phosphate (LFP) battery packs. The results indicated that dry chemical and Class D powder could extinguish the fire temporarily, but a reignition occurred. Water mist was able to extinguish the battery fire completely with continuous cooling of the battery to prevent the reignition. The suppression results for both NMC and LFP chemistries were also compared. These test results can be used to develop appropriate firefighting strategies for safe and effective suppression of battery fires in a mine.

2:00 PM - Analyzing the Effectiveness of Fire Suppression Systems to Extinguish a Fire on Mobile Mine Equipment Used in the Mining Industry by James H Rowland III, NIOSH, Pittsburgh Mining Division, Email: JRowland@cdc.gov

Abstract: To reduce the number of injuries resulting from fires on mobile, diesel-powered mine equipment, it is crucial to promptly suppress a fire once it is detected. The focus of this research was to determine the effectiveness of fire suppression agents. Large-scale tests were conducted using five different fire suppression systems based on: dry chemical, wet chemical, dual agent (dry and wet chemical), carbon dioxide, and water mist. Suppression nozzles were placed around the diesel engine where diesel fuel, engine motor oil, and hydraulic circulating oil spray fires were ignited. The results of this study can help mining companies and manufacturers by providing scientifically based data on the capabilities of the different fire suppression systems.

2:20 PM - Human Robot Interaction in Underground Mine Search and Rescue Robot by Roya Bakzadeh, University of Kentucky, Email: roya.bakzadeh@uky.edu

Abstract: This work presents the development of sophisticated multi-agent robotic systems, specifically focusing on the design and integration of an unmanned ground vehicle (UGV) equipped to transport an unmanned aerial vehicle (UAV) for search and rescue missions in underground mine environments. The UGV, designed for entry into mines when pathways are accessible, incorporates a specialized compartment that houses the UAV along with sensors and communication nodes, essential for maintaining operator communication. The UAV is distinguished by its ability to perform high-maneuverability tasks such as mapping, data collection, and exploration in areas of the mine inaccessible to the UGV. Additionally, this work delves into the ongoing efforts to enhance the robot's capabilities to align with the operational requirements of search and rescue teams. A significant portion of the research is dedicated to establishing a framework for Human-Robot Interaction (HRI), aiming to define optimal collaboration strategies between search and rescue personnel and robotic systems in diverse operational scenarios. Furthermore, the study investigates the regulatory landscape governing the deployment of such robotic systems in underground mining contexts, highlighting the challenges and considerations involved in their implementation. This comprehensive approach not only advances the technical capabilities of search and rescue robotics but also addresses the critical aspects of human interaction and regulatory compliance, setting a foundation for future developments in the field.
2:40 PM - Lessons Learned from Near-Miss Events: Use of the Critical Decision Method to Identify Strategies to Improve Haul Truck Safety in Mining by Jennica L. Bellanca, NIOSH, Pittsburgh Mining Research Division, Email: Jennica.Bellanca@cdc.gov

Abstract: Accidents involving powered haulage and mobile equipment such as haul trucks often account for the greatest number of fatalities in the mining industry each year. Despite previous analyses that have identified root causes and other contributing factors, there is still a need to better understand the events leading up to these types of accidents, what lessons may be learned, and what strategies can be employed to prevent fatal accidents from occurring. This study examines Naturalistic Decision Making (NDM) using the critical decision method (CDM). The CDM is a retrospective interview approach used to explore time-limited, high-stakes, decision-making. In this study the CDM is used to obtain more information about what happens prior to, during, and after a potentially fatal situation such as a near-miss event, loss of control, or minor accident involving equipment damage. Researchers captured first-hand accounts from 21 haul truck operators involved in near-miss events from mine sites of various sizes and commodities throughout the United States. These accounts provide rich and detailed narratives from the perspective of haul truck operators themselves and reveal insights into what decisions haul truck operators make, what sensory cues they perceive, and what strategies they employ during challenging and non-routine situations. Decision-related themes that emerged from the data are presented and discussed. These results, along with potential solutions offered by study participants, can help to inform future research, raise awareness about hidden hazards, and build more creative interventions and realistic training scenarios for use by the industry to address haul truck safety issues.

2:55 PM - Closing Remarks

3:00 PM – Session Closed – Next Webinar: Thursday May 30, 2024
Thursday, May 30, 2024 – Ventilation
Session Chair: Khaled Mohamed, NIOSH

12:45 PM - Open the Zoom Meeting Seminar (Authors Only)

1:00 PM - Opening Remarks

1:05 PM - Reducing Operator Exposure to Respirable Dusts - Tangible Highlights of NIOSH and Industry Partnerships by Milan Yekich, NIOSH, Pittsburgh Mining Research Division, Email: vgz7@cdc.gov

Abstract: NIOSH mining has conducted two decades of enclosure filtration research in both lab and field environments. This experience has led to the publishing of essential design considerations for effective enclosure air filtration systems. When these principles have been adopted by suppliers (both OEMs and aftermarket filtration system manufactures) there is an increased likelihood of a successful filtration system and reduced operator exposures. Future systems being developed will further integrate key design components with today’s technologies which can monitor, maintain and improve the air quality in enclosed cabs while making performance feedback salient to both the operator and maintenance staff.

1:20 PM - Characterizing Fires in Underground Mine Ventilation Networks Using Machine Learning by Davood Bahrami, PhD, NIOSH, Pittsburgh Mining Research Division, Email: hwh0@cdc.gov

Abstract: Underground mine accidents, such as mine fires, remain a health and safety risk to mine workers. Researchers at the National Institute for Occupational Safety and Health developed a data-driven, predictive model that shows promise in characterizing unknown underground fires for their size and location. This paper describes the application of the methodology to small and large, underground, mine ventilation networks using simulated airflow data. The results show the size and location of an unknown fire can be determined with over 80%, and 90% accuracy, respectively, and potentially reduce the risk of hazardous conditions for emergency response.

1:40 PM - Estimating Air Blast Velocity Using an Optical Flow Algorithm by Vasu Gangrade, NIOSH, Pittsburgh Mining Research Division, Email: ytb7@cdc.gov

Abstract: Large-opening underground stone mines pose significant ground control challenges, including the risk of massive pillar collapses. These collapses can result in dangerous air blasts characterized by tremendous force and high velocity. Estimating the velocity of these air blasts proves challenging due to the absence of accurate air velocity instruments near the mine portals. To address this issue, this paper proposes a novel approach that leverages closed-circuit television camera footage from the mine. Specifically, it employs the optical flow algorithm implemented in Python to estimate the
velocity of the air blasts, providing a valuable tool for assessing and mitigating risks in such mining environments.

2:00 PM - A Gas Chromatography-Based Method to Distinguish Coalbed Methane from Non-Coal Gas Sources in the Northern Appalachian Basin by Steven J. Schatzel, PhD, NIOSH, Pittsburgh Mining Research Division, Email: zia6@cdc.gov

Abstract: The National Institute for Occupational Safety and Health (NIOSH) has been conducting research related to unconventional gas wells positioned in abutment pillars associated with active longwall mining in Southwestern PA and the associated tri-state region. The Ventilation and Explosion Prevention Team at NIOSH is working toward predicting and characterizing a hypothetical casing breach and its effect on the safety and health of mine workers, gas well workers, and the general public. An important aspect of this research is to distinguish coalbed gas from shale gas in the mine environment as an indicator of a casing breach. Another non-coal gas source exists in the region in the form of underground gas storage fields which also have the potential to migrate towards mine workings. During a hypothetical gas breach, the addition of excess natural gas to coal mine environments will exceed the anticipated ventilation loading and can create a mine explosion hazard. A methodology has been developed to distinguish these gas sources. Gas samples from the three sources were analyzed by gas chromatography (GC), and interpretive methods were applied to distinguish the populations. The data are plotted on bivariate graphs using the hydrocarbon index and the molecular ratios. These plots showed that the sources occupy different regions of the graphs where non-coal gas contained under 1% CO2, and all coal samples included greater than this value. Previous findings on compositional trends from coal and non-coal sources are consistent with what is reported, supporting a GC-based method in distinguishing these sources. On our original data set, a multivariate T-squared (T2) test analysis relating data in pairs showed a low p-value (dimensionality parameter) and a high T2 test statistic for all comparisons, indicating that these sources are different and distinct gas populations. An expanded data set will be presented which shows the continued discrimination of gas sources by the proposed method. Ultimately, stakeholders from the mining and gas production industries can utilize this method to identify gas sources and a potential casing breach.

2:20 PM - Optimization of Fan Placement and Stopping Pillar Placement Using Numerical Modeling by Marcia L. Harris, NIOSH, Pittsburgh Mining Research Division, Email: ztv5@cdc.gov

Abstract: NIOSH has conducted ventilation surveys in an underground stone mine using natural ventilation. The mine operator is seeking to optimize the natural ventilation to the working faces to prevent DPM accumulations during active work hours and to evacuate blasting fumes at the end of the workday. NIOSH researchers created a CFD model showing the volumetric flows, effects of fan placement, and effects of stopping placement and design. This paper details the initial surveys and model calibration with the intent to optimize future fan and stopping placements. Other stone mines can use this information in their initial ventilation and development planning.
2:40 PM - Case Study on the Abnormal Airflow Diagnosis Method Using Atmospheric Monitoring Data by Lihong (Lilly) Zhou, PhD, NIOSH, Pittsburgh Mining Research Division, Email: itn2@cdc.gov

Abstract: A stable and well-maintained mine ventilation system is the key to ensuring a safe and healthy working environment for miners. A sudden, unplanned, and significant change in airflow termed as abnormal airflow is frequently observed in mine ventilation. Some abnormal airflows can return to normal without manual intervention; however, some abnormal airflows may cause catastrophic accidents if left unattended. In addition, abnormal airflow may be a consequence of an accident such as a blocked airflow route due to a roof fall. Promptly diagnosing and locating the cause of abnormal airflow can help prevent accidents. Researchers at the National Institute for Occupational Safety and Health (NIOSH) have developed a method to diagnose the cause of abnormal airflow for underground mine ventilation systems. The purpose of this paper is to verify the developed method using experimental tests conducted at NIOSH's experimental mine. The airflows were monitored by a real-time atmospheric monitoring system installed in the experimental mine during the tests. As demonstrated in this case study, the developed abnormal airflow diagnosing method, based on the resistance sensitivity and matching method, has been proven to be reliable.

2:55 PM - Closing Remarks

3:00 PM – Session Closed – Next Webinar: Tuesday June 4, 2024
Tuesday, June 4, 2024 - Special Panel Discussion
Session Chair: Mike Keener, CONSOL Energy

12:45 PM - Open the Zoom Meeting Seminar (Authors Only)
1:00 PM - Opening Remarks
1:05 PM - Panel Discussion - State of the Mining Industry Workforce

Planned Panelists:

Dave Beiber, PG, PGP, CEG, CHG
Mining and Geological Consultant and
Adjunct Professor of Mining Engineering, Colorado School of Mines

Andrea Brickey, PE, PhD
Professor, South Dakota School of Mines and Technology

Brittany L. Taylor,
Principal, Canon-McMillan High School

Abstract: There has been a shift in the workforce, not just in the mining industry but several other industries. A shift so great in fact that the period around the Covid-19 Pandemic is being referred to as "The Great Reshuffle." The purpose of this panel discussion is to highlight what those changes are, what problems or issues they could cause, and possible solutions to address them. Panelists from industry and academia will provide varied perspectives of the current and future mining industry workforce.

2:55 PM - Closing Remarks

3:00 PM - Session Closed - Next Webinar: Thursday June 6, 2024
Thursday, June 6, 2024 - Dust and Processing and Extraction
Session Chair: Tim Beck, Commissioned Corps of the U.S. Public Health Service

12:45 PM - Open the Zoom Meeting Seminar (Authors Only)

1:00 PM Opening Remarks

1:05 PM - Case Studies of Video-Assisted Exposure Monitoring for Respirable Mine Dust by Milan Yekich, NIOSH, Pittsburgh Mining Research Division, Email: vgz7@cdc.gov

Abstract: Real-time monitors can provide important information on the exposure of workers to respirable dust and spatial-temporal evolution of the concentration in the mining environment. The combination with video monitoring has been proposed as an approach to collect contextual information critical for analysis and decision making. The implementation of this approach is presented in this contribution through four cases studies from NIOSH researchers, an Australian consultant firm, and two mining companies in the US and Canada. The case studies will describe details and examples of data collection, data interpretation and manipulation and in general benefits and limitations of this approach.

1:20 PM - Modelling of Thermo-Fluids in Underground Mining by Khadija Omar Said, The Pennsylvania State University, Email: kos5600@psu.edu

Abstract: Mine ventilation is crucial for ensuring safe and sustainable operations in underground mines. The process does not only provide fresh air to the miners but also prevents the overheating of machines when running. Based on its importance, the provision of optimum ventilation in mines is a crucial necessity. This is because insufficient air can result in the suffocation of miners and overheating of machines. On the other hand, an excessive supply of air narrows down profit margins and also, increases the prerequisite of combustion, oxygen. Various studies have attempted to employ different ventilation optimization techniques. Most studies have reported the prowess of computational fluid dynamic modeling in ventilation design. However, given that ventilation parameters are dynamic, CFD is time-consuming and costly to be constantly employed for ventilation optimization. To overcome this drawback, this study attempts to demonstrate the suitability of tuning results from mathematical models to match the output from CFD models. This is achieved by modeling airflow through a tunnel using CFD and mathematical modeling using partial differential equations (PDE). Output from the PDE model is then tuned to match the result from the CFD model.

1:40 PM - Canopy Air Curtain to Reduce Diesel Particulate Matter Exposure for Underground Blasters by Steven Mischler, PhD, NIOSH, Pittsburgh Mining Research Division, Email: smischler@cdc.gov
Abstract: Diesel exhaust is considered a carcinogen to humans by the International Agency for Research on Cancer (IARC). Miners are one of the highest exposed occupations, and those who work outside of cabs, such as underground blasters, can be the highest exposed working groups. One potential control technology to reduce these exposures is a canopy air curtain (CAC) which has been demonstrated to successfully reduce respirable coal mine dust exposure for roof bolters and shuttle car operators. This manuscript presents the results of a study evaluating the use of a CAC to reduce diesel particulate matter (DPM) exposure of underground blasters.

2:00 PM - Real-Time Dust Monitoring in Occupational Environments: A Case Study on Using Low-Cost Dust Monitors for Enhanced Data Collection and Analysis by Cody Wolfe, PhD, NIOSH, Pittsburgh Mining Research Division, Email: yvv5@cdc.gov

Abstract: A worker’s personal exposure to respirable dust in occupational environments has traditionally been monitored using established methodologies which entail the collection of an 8-hour representative sample that is sent away for laboratory analysis. While these methods are very accurate, they only provide information on the average exposure during a specific time period, generally a worker's shift. The availability of relatively inexpensive aerosol sensors can allow researchers and practitioners to generate real-time data with unprecedented spatial and temporal granularity. Low-cost dust monitors (LCDM) were developed and marketed for air pollution monitoring and are mostly being used to help communities understand their local and even hyper-local air quality. Most of these integrated sensing packages cost less than $300 per unit, in contrast to wearable or area dust monitors specifically built for mining applications which have been around for decades but still average around $5,000 each. At the National Institute for Occupational Safety and Health (NIOSH), we are leveraging the power of high-volume data collection from networks of LCDM to establish baseline respirable hazard levels and to monitor for changes on a seasonal basis as well as following any application of control technologies. We have seen the effective use and advantages of monitoring live data before, during, and after events like shift changes, operational changes, ventilation upgrades, adverse weather events, and machine maintenance. However, many factors have prevented a systematic adoption of LCDMs for exposure monitoring: concern for their analytical performance, the complexity of use, and lack of understanding of their value are some factors. This contribution outlines a one-year case study at a mine in Wisconsin USA, covering the installation, maintenance, data visualizations, and collaboration between NIOSH researchers and the industrial hygiene professionals at the mine.

2:20 PM - Whole-of-Plant Ultra-Fine Particle Dewatering for Valorization and Dry Stacking by Mike Barish, Somerset International, Email: mbarish@somersetint.com

Abstract: Somerset International has partnered with Warrior Met Coal at the #7 Plant to install a Whole of Plant Ultra-Fine Particle Dewatering System. It is designed to achieve maximum coal recovery and allow for dry stacking of thickener underflow for comingled
disposal. The system consists of eight (8) operating Sub325® solid bowl centrifuges and two (2) Effluent Concentrators (patent pending). The Valorization step involves four of the centrifuges and both concentrators to treat the ultra-fine particles to recover coal from the thickener feed and place it on the clean coal conveyor. The Dry Stacking step involves the other four operating machines, plus one spare, to dewater the thickener underflow for discharge onto the refuse conveyor for comingled disposal. Dry Stacking eliminates the need for a slurry pond. This paper will discuss the phased installation of the entire Somerset system from initial design to final commissioning.

2:40 PM - Sustainable Extraction of Critical Minerals from Primary and Secondary Sources by Mohammad Rezaee, PhD, The Pennsylvania State University,
Email: m.rezaee@psu.edu

Abstract: The United States and the world have seen exponential growth in critical minerals for various applications, ranging from sustainable energy and national defense to modern electronic and medical applications. The United States is heavily reliant on foreign sources of these minerals. To address the needs for these minerals, it is critical to extract them from all viable sources including secondary sources such as mining and processing waste streams and electronic waste. This presentation covers ongoing research and development in my research group on developing sustainable processes to address the challenges of extraction of critical minerals from primary and secondary sources.

2:55 PM - Closing Remarks

3:00 PM – Session Closed – Next Webinar: Thursday June 11, 2024
12:45 PM - Open the Zoom Meeting Seminar (Authors Only)

1:00 PM Opening Remarks

1:05 PM - Raising the Roof Effectively! The Importance of Hydraulic Integrity in Powered Roof Support Installations in Maintaining Good Mining Conditions by Nigel Goff, Komatsu Mining Corporation, Email: nigel.goff@global.komatsu

Abstract: Longwall Powered Roof Support installations are designed to meet criteria specific to creating effective resistance to the roof. Modern longwall faces now have increased equipment longevity with multiple faces aging to the 20-year range and new supports often designed for a service life of 50000 cycles. Advancements in individual longwall component capability within the life cycle of the face, increase of face length and general maintenance of hydraulic integrity are all factors that can lead to reduced hydraulic performance and the ability of the PRS achieving design support density within a timeframe that halts roof stability degradation and maintains acceptable face conditions. The presentation examines common potential causes that can lead to extended support set times, how these can be assessed with tools readily available from design tools using Computational Fluid Dynamics (CFD) to day-to-day passive data surveillance analysis on automated faces and simple strategies to ensure that you can still ‘Raise the roof effectively.

1:20 PM - Rockmass Permeability Changes by Longwall Mining: Predictions and Field Measurements by Zoheir Khademian, PhD, NIOSH, Pittsburgh Mining Research Division, Email: ZKhademian@cdc.gov

Abstract: Predicting rockmass permeability is critical in evaluating various engineering designs, including estimating gas inflow to a longwall mine in the case of a hypothetical breach in the gas well. This study conducted field permeability measurements to validate a geomechanical model capable of predicting rockmass permeability during longwall mining. A series of slug permeability tests were conducted in an active mine in Pennsylvania. A model of the mine was constructed in 3DEC numerical modeling software, and permeabilities were calculated. The modeling results agreed well with the pre- and post-mining permeability measurements, showing the applicability of this tool to evaluate gas well stability near mine workings.

1:40 PM - TSF/CAP Safety, Awareness, Operational Support by John Metzger, AssetAssurance Monitoring, Email: john.metzger@aamonitoring.net

Abstract: Risk Reduction Monitoring is a process championed by fellow geologists and colleagues in the mining and civil/geohazards sector as a part of near real-time monitoring
assignments carried out at mines, along highway corridors, and across wide areas through remote sensing. The application of Subject Matter Expert guided practices further strengthened the method and the experience. At the request of Tailings Dam design and construction staff, supported by site operations, production, and third-party consultants we began investigating the application of general remote sensing capabilities on instruments like the USGS LANDSAT 8/9, and ESA Sentinel-2 satellites. Both missions acquire near-global coverage on an 8-16 day and 3-5 day cadence respectively. Landsat datasets have been homogenized to create a nearly 50+ year archive of Earth observations to date. The active Sentinel-2 archive spans 9 years at present. Our mine site experiences and practices evolved from serial differential monitoring, and awareness and application of seminal Geo-Applications have resulted in The Tailings and Impoundments Reflectance Index (TIRI), the Water Incident Reflectance Index (WatIRI), the Temperature Incident Reflectance Index, and the Vegetation E-Check or VegECheck -- areal differential change scenario toolset. We apply these for geotechnical, Tailings and Mine Waste, and Environmental staff at mine sites across the globe. Our system utilizes open-access or commercial imagery, it provides shareable and exportable data ready for common GIS systems, online portals, and portable device platforms. The value driver in applying these RRM-centric data sets is NRT safety, operational, and compliance practices we refer to as due diligence. Our presentation details a selection of sites where tailings depositions influence operation and production, historical issues and components of EPA BU, state and other agency reclamation and or environmental compliance practices, or specific aspects of coal ash pond management.

2:00 PM - Satellites & Soil Moisture: Protecting Tailings Dams from Space by Yonatan Rabinovitch, ASTERRA, Email: yonatan.rabinovitch@asterra.io

Abstract: Recent commercial uses of L-Band SAR in the water industry for the detection of water leaks has led to further developments in its application within the ground engineering industry to determine the concentrations of sub surface soil moisture which can be indicative of potential problems within earthwork assets, road pavements and rail beds. L-Band SAR has also been explored for use in tailings storage facilities (TSF) and earth dams monitoring and safety. Internal erosion of TSF and earth dams is one of the major causes of failure, the consequences of which are far reaching including loss of life, environmental disaster, loss of reputation and significant financial penalties. Signs of internal erosion do not often manifest themselves at surface, hence visual inspection and non-targeted investigations or instrumentation, are unlikely to detect the tell-tale signs that seepage or erosion is present. L-Band SAR has the ability to detect moisture below the ground surface and determine the presence of high soil moisture concentrations which may be indicative of areas of internal seepage, in advance of this manifesting itself at the surface. The use of proven algorithms allows L-Band SAR data to be converted to soil moisture content which can be displayed as contours for engineers and asset owners to view potential areas of concern and verify existing problem areas. This crucially provides the operator with time. The time required for targeted inspection, investigation and the design of intervention measures, to prevent potential catastrophic failure of their
assets. Following the devastating failure of the Brumadinho TSF in Brazil in 2019, the mining industry and indeed those responsible for any earth dams are keen to demonstrate their full understanding of their assets, relative to safety and risk. L-Band SAR can assist these asset owners to address their responsibilities in terms of dam safety, enabling appropriate direction of resources and funding to the areas needed, and targeted interventions and maintenance for the prevention future failures and the increase in safety.

2:20 PM - Industry Experiences with Mineworker Fatigue: Findings from a Needs Assessment by Zoe Dugdale, NIOSH, Spokane Mining Research Division, Email: nxl4@cdc.gov

Abstract: This study aims to ascertain the extent to which fatigue remains a concern in the US mining industry, to learn about what mine sites are doing to monitor and manage worker fatigue, and to gather feedback around what additional information or resources are needed. Mineworkers are particularly susceptible to fatigue due to simultaneously occurring work-related hazards, including but not limited to dim lighting, heat/cold, noise, vibration, noxious/toxic fumes, long commute times, remote/rural work locations, monotonous/disengaging tasks, and manual labor. Fatigue in mining can lead to potentially serious health and safety related outcomes because mineworkers must constantly monitor and respond to these hazards in an ever-changing environment with numerous workers and large earth-moving equipment present. Although there is a strong case to be made for studying the prevalence, causes, and mitigation strategies for fatigue in U.S. mining, to date there has been very little intervention work done in this area (Bauerle et al., 2021; Dugdale et al., 2022). To properly understand, assess, and respond to the problem of mineworker fatigue, a needs assessment was warranted.

2:40 PM - US Experience in Controlling the Effects of MIS on Surface Structures by Hamid Maleki, PhD, PE, Maleki Technologies, Inc., Email: maleki.tech@yahoo.com

Abstract: This paper reviews the Mining Induced Seismicity (MIS) mechanism and effects on essential and sometimes critical structures using the experience in the western United States and numerical modeling for control of seismicity through structural mine designs. In the western U.S., longwall mining technique have been extensively used for the extraction of coal resources in proximity to essential surface structures including roads and small impoundment dams. The only critical structure which was recently longwalled at a short distance (<2,000-ft), is an earthen dam located on the Book Cliffs, Utah. Mining was conducted in conjunction with geotechnical investigations/inspections both during and after completion of mining (2004-2017). The geotechnical investigations were conducted by an independent third-party with ongoing communication with both the government and the local populace. The effects are analyzed in this paper addressing geotechnical risk factors and measures taken by the operator to control the risk through reduction of the extraction ratio and mine layout designs as mining approached the study areas.
2:55 PM - Closing Remarks
3:00 PM – Session Closed