

9:45 AM

If the Technology Fits: An Evaluation of Mobile Proximity Detection Systems in Underground Coal Mines

L. Swanson and J. Bellanca; Pittsburgh, PA, CDC NIOSH, Pittsburgh, PA

Even though proximity detection systems for mobile machines (mobile PDS) have the potential to decrease injuries and fatalities, some mine operators and managers have experienced challenges integrating the systems. Applying task-technology fit, this study investigates the fit between mobile PDS and mining relative to health and safety. This study evaluates fit from the perspective of leaders at two coal mines. Quantitative results show that mine leaders evaluated mobile PDS favorably for training and ease of use, system feedback, user authorization and experience, and less favorably for safety, compatibility, task completion, and reliability. Qualitative results reveal specific task, mine, and system characteristics that may have influenced leaders' evaluations. The study includes considerations and recommendations for safe technology integration.

10:05 AM

Investigation on the Creation of Stereoscopic Images Using Infrared Cameras

S. Gaab; Department of Mining and Metallurgical Engineering, Mackay School of Earth Sciences and Engineering, Reno, NV

Since infrared cameras are robust to harsh environments, they draw interest in various application fields of the mining industry. This thesis investigates how to recover 3D-information of a scene from infrared images, based on photogrammetry. Different camera lenses, objects and processing software were used to obtain point-clouds. A best practice was derived, including following findings: Normal lenses are more suitable than wide-angle-lenses and objects preferably show several unique and small-sized points. Contrary to common expectations, some software generates less-accurate point-clouds with an increasing number of populated images. Prospectively, this thesis could serve as foundation for standardizing 3D-data acquisition through infrared.

10:25 AM

Usage Paradigms for Synthetic Learning Environments: Strategies and Lessons Learned

L. Brown¹, B. Granillo² and M. Poulton¹; ¹Lowell Institute for Mineral Resources, University of Arizona, Tucson, AZ and ²Mel & Enid Zuckerman College of Public Health, University of Arizona, Tucson, AZ

Synthetic Learning Environments (SLEs) support acquisition of expert knowledge by combining best practices in adult learning, realistic simulation, and serious games. Reflecting on five years of experience, we have found SLEs to be useful not only in training but also for a wide range of organizational planning and risk assessment use cases. Applying insights gleaned from testing with hundreds of mine workers and field deployments at sites across the US, we propose a series of nine usage paradigms, which include 1) Assessing "true self" and risk-taking behaviors; 2) Reinforcing and evaluating competencies; 3) Preparing for drills and apprenticeship; 4) Supplementing training for specific deficiencies; 5) Providing modules for scenario-based training; 6) Developing worker job action sheets; 7) Performing job hazard analysis; 8) Enhancing standard operating procedures; and 9) Testing resiliency in emergency response plans. In this talk, we will provide investigator perspective and examples based on our experience with both "Harry's Hard Choices," an SLE for mine emergency response and evacuation, and "Harry's Hazardous Day," an environment for hazards recognition and mitigation.

10:45 AM

Visualization of AI Results for Big Data of Underground Mines in Virtual Reality

E. Isleyen and S. Duzgun; Mining Engineering, Colorado School of Mines, Golden, CO

Underground mines are complex environments in terms of data collection, analysis and visualization of analytics results for making decisions. Artificial intelligence (AI) methods used for big data from a large number of different sensors provide opportunities of understanding hidden patterns. Three-dimensional self-organizing maps (3-D SOM) are one of the effective AI methods for revealing patterns in the data sets. This study presents a framework to visualize 3-D SOM results in virtual reality (VR) for underground mines. A set of sensor data from an underground mine, is analyzed using SOM and the resultant topological map for data points are visualized in the virtual underground mine. The results indicate that visualization of AI outputs in virtual reality serves as effective tool for building situational awareness.

Health and Safety of miners is the most important issue that should be provided by companies. Many solutions are being provided to ensure the safety of mining workers in recent years. Tracking of miners in a real-time manner is one of the methods to take critical precautions before and after the mine accidents. The realtime tracking can be achieved in open areas with the help of global positioning system (GPS). However, the smartness of the system and indoor tracking that provides this service should be achieved by the new technological developments. In this study, a unique RSSI-dependent algorithm is developed with the RFID technology. The technique applied in this study is the fingerprint. The signal map of each mine should be collected and configured is the only disadvantage of fingerprints technique. The methodology is applied in this study is unique and a kind of integrated solution. The solution is applied in a metallic mine and now being used in 25 underground metallic mines in Turkey. The accuracy of the system is 5m. In future, not only the localization of miners but also performance and productivity of mines should be configured by these type of communication system.

11:05 AM

RSSI-Based Indoor Localization System for Smart Mining Operations: A Case Study

M. Cavur¹, M. Camalan³ and S. Duzgun²; ¹Management Information System, Acemician, Istanbul, Turkey; ²School of Mines, Academician, Denver, CO and ³Mining Department, Academician, Ankara, Turkey

Health and Safety of miners is the most important issue that should be provided by companies. Many solutions are being provided to ensure the safety of mining workers in recent years. Tracking of miners in a real-time manner is one of the methods to take critical precautions before and after the mine accidents. The realtime tracking can be achieved in open areas with the help of global positioning system (GPS). However, the smartness of the system and indoor tracking that provides this service should be achieved by the new technological developments. In this study, a unique RSSI-dependent algorithm is developed with the RFID technology. The technique applied in this study is the fingerprint. The signal map of each mine should be collected and configured is the only disadvantage of fingerprints technique. The methodology is applied in this study is unique and a kind of integrated solution. The solution is applied in a metallic mine and now being used in 25 underground metallic mines in Turkey. The accuracy of the system is 5m. In future, not only the localization of miners but also performance and productivity of mines should be configured by these type of communication system.

MONDAY, FEBRUARY 25

AFTERNOON

1:30 PM | ROOM 113

Dreyer Lecture: Why Choose Industrial Minerals For A Career Path

Recipient and Lecturer: Dennis P. Bryan

MONDAY, FEBRUARY 25

AFTERNOON

2:00 PM | ROOM 507

Bulk Material Handling: Conveyor Maintenance and Safety

*Chair: N. Madison, Cornerstone Conveyor
Engineering, Fayette, AL*

2:00 PM
Introduction

2:05 PM
**Constructing Toromoch's 5.2 KM Conveyor
through the Andes Mountains**

C. Torres and E. Michiels; Maccaferri Mining Solutions, Lithia, FL

Constructing a 5.2 KM conveyor has many challenges, combine that with building it at nearly 5,000m in elevation through the Andes mountains and it can be hazardous. Identifying the structure's best travel path still required a 250m climb, a 300m decent as well as 7 horizontal turns. This path still left the conveyor exposed to falling debris and ice, the construction of a 20m reinforced slope and a tunnel to allow vehicles to cross the structure. Construction at this elevation is challenging and the weather; wind snow and rain, can be quite a burden on the installation crews. For the safety and construction timeline experienced crews were necessary to construct various aspects of this project. This presentation will share design and construction details on the rockfall protection system, the MSE wall supporting this massive conveyor and the tunnel on this project.

2:25 PM
**Bulk Material Flowability Testing – What Is It and Why Does
It Matter?**

C. Hartford and T. Holmes; Jenike & Johanson, San Luis Obispo, CA

Bulk solids handling systems are often the weakest links in the process plant, and their performance can dictate the performance of the entire operation. Therefore, they deserve special attention. When designing a bin, hopper, transfer chute, or stockpile for a bulk material, it is critical to understand how the bulk solids will "flow" through the system. Flowability is a function of the material and the equipment handling it. A "free-flowing" material placed in poorly designed equipment may have difficulty flowing reliably. Similarly, a material that seems difficult to handle placed in the correct equipment may flow without a problem. When designing a liquids plant, the density and viscosity of a liquid is looked up or tested and used as a design parameter. With bulk solids, the design process is similar except the friction, cohesive strength, compressibility and sometimes permeability need to be measured for the material. It is important for these tests to be run at representative process conditions. Measuring flow properties and applying them correctly will reduce project risk and potentially save a significant amount of capital.