Was that thump "drummy" or "tight"?

Developing a better scaling bar for underground potash mines

Saskatchewan mining companies have a variety of safety precautions and protocols in place, including a method that experienced miners use to ensure that the underground space they are in is safe. Miners use what is called a "scaling bar" (a long metal rod) to gauge the ceiling stability of underground tunnels. The scaling bar is tapped on the ceiling and an experienced miner can interpret the resulting sound to determine if the ceiling is stable. A hollow "drummy", low frequency sound indicates that there may be voids in the roof of the tunnel and further precautions are required. A higher frequency, "tight" sound indicates that the ceiling is sound and work can proceed in that underground space. Although very convenient and low cost, the scaling bar measurement is highly subjective – it relies on the experience of the person doing the test and interpreting the sounds.

In order to create a more robust measurement system that is not reliant on user interpretation and can be used by personnel with varying degrees of underground experience, researchers at the University of Saskatchewan proposed a project to investigate developing a better scaling bar. The project, called **Preliminary Quantification of Scaling Bar Impacts for Underground Mine Safety**, proposed to establish the feasibility of developing a scaling bar device capable of providing a simple to understand, visual "safe-unsafe-unknown" measurement. The measurement could then be used to decide whether more stability testing or more structural support is required.

Using a scaling bar, a microphone and recording device attached to a tripod, impact sound data was collected from five different Nutrien and Mosaic mines. At the time of testing, each individual impact was categorized as "drummy" or "tight" by an experienced miner. One of the objectives of the project was to create a machine-learning algorithm, where custom made software is "trained" to categorize sound patterns as either drummy or tight. The researchers were able to isolate the characteristic part of the sound signal (reducing the data storage and analysis requirements) and from this information, machine learning algorithms were created and tested against uncategorized sound data. The algorithms produced great results – the sound signal classification (i.e. "Is the sound drummy or tight?") error (within one facility) was below 1%.

This project demonstrated that the sounds produced by a scaling bar tapping the ceilings could be measured reliably. The next steps, which will be part of a new project to be executed in 2020, include developing an "all-in-one" prototype with visual indicators (red-yellow-green lights) that can be attached to a conventional scaling bar, refining the machine learning algorithm, and making the prototype robust to external noise sources like fans or running machinery.

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Project Duration: **Jul 2018 – Mar 2019**

Project Cost:	**$29k**
IMII (cash):	$25k
Industry (in-kind):	$ 4k

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