ACM NEWS

Researcher Develops nderground Wireless Communication For Mines

By Ryerson niversity
July 28, 2010
Comments

Ryerson University Electrical and Computer Engineering professor Xavier Fernando is developing life-saving technology for miners.

Credit: Dave Upham / Ryerson University

In recent years, the tragic story of mine accidents has been retold many times in international headlines. But thanks to the work of Ryerson University researcher Xavier Fernando, countless miners' lives could be saved in the future with state-of-the-art technology that makes wireless communication possible deep within the Earth's crust.

Fernando, a professor in Ryerson's Department of Electrical and Computer Engineering, is designing and developing highly reliable underground wireless communication systems that will ensure miners' safety before and after disasters.

"Ever since the United States passed the MINER [Mine Improvement and New Emergency Response] Act of 2006 [the country's most significant mine safety legislation in 30 years], there has been much more interest in the area of underground communications," Fernando says. "The mining industry is excited; it has been looking for better and more reliable forms of communication."

In the harsh environment and changing topology of a mine, reliable communication is a high-stakes issue. While cell phones have become the default means of communication in the mainstream, since their basestations are located above ground, they are unfortunately useless underground. In addition, disasters can bring down electricity and communications cables, block tunnels and cause fires—all of which may hamper rescue efforts and endanger lives.

In response to these challenges, Professor Fernando is making use of an innovative technology to provide communications coverage for confined spaces such as mines and tunnels. His solution to bringing signals underground is transmitting radio signals over optical fibers (ROF). This ROF technology provides enough bandwidth to handle and maintain signals underground. What's more, optical fibers are readily available and are unaffected by the electromagnetic interference or radiation commonly emitted by mining equipment.

ROF is already used to provide wireless-communication access to the $985-million Niagara Tunnel, a massive hydroelectricity project sponsored by Ontario Power Generation. ROF also played a significant role in the 2000 Summer Olympics in Sydney, Australia. The wireless network there was able to support 500,000 phone calls during the Opening Ceremonies.

In the mining industry, ROF technology can also help officials identify miners and continuously track their movements. Therefore, in the event of a collapse, it would be easier to predict where each miner is located.

While ROF technology offers many solutions, it also presents a problem: since fiber-optic communication lines are not linear, signals can be scattered, creating distortion at the receivers. However, Fernando has created and holds a patent for an algorithm that almost entirely compensates for the distortion.

Partnering with Mine Radio Systems of Goodwood, Ontario, the potential applications for the professor's work are myriad—there are numerous mining and tunneling projects underway around the world, and each one of them requires high-tech communication systems.

To the same end, Fernando is also investigating a system of "Through-the-Earth" (TTE) signaling. Unlike higher-frequency communications, the ultra-low frequencies used in TTE technology [approximately 10 kilohertz] can penetrate water and rock. This capability would be invaluable to the mining industry as well, Fernando says.

"With this technology, officials could still maintain communication with a miner who is trapped and is likely covered by dirt and rocks."

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