TECHNICAL PROGRESS REPORT

Quarterly Report

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ABSTRACT

Progress continued along both subsystems towards an integrated comprehensive wireless communications system for the underground mining industry. Designing an automated continuous self-tuning mechanism that optimizes signal transmission intensity for a given power input enhanced through-the-earth communications. In-mine communications was enhanced through the design of a circuit that eliminates multi-antenna interference, cleaning-up the received signal.

TABLE OF CONTENTS

Research, development, and experimental

The project proceeded along the work involving two subsystems, as was proposed in our application for funding, to develop a comprehensive wireless communications system for the underground mining industry. One subsystem (the TTE system) will provide wireless communication through the earth between the interior of a mine and its surface, while the second subsystem (the IM system) will provide wireless in-mine communication throughout the mine interior without the need for the installation of a dedicated wired network. The two subsystems will be integrated to provide comprehensive mine-wide, two-way, wireless communication including communication between the mine interior and the surface.

For the development of the TTE system, two transceivers were assembled into two prototypes suitable for fieldwork, and the prototypes were tested. The transceivers use two large loop antennas (60 feet diameter), one on the surface (or buried several feet under the surface for protection), while the other is wrapped around a pillar inside the mine. To facilitate signal transfer between the surface and the mine interior, the antennas must be tuned. In early experiments we found that the best tuning varies from site to site because of different properties of the strata as well as the specific antenna geometry, and even from day to day at a given site depending on weather conditions. The tuning includes tuning for center frequency and for bandwidth to allow the required frequencies to be transmitted.

Manual tuning in the field is very difficult even if it were necessary to do so only once. It is completely impractical to carry out manual tuning under varying conditions. Therefore, we decided to implement continuous automatic tuning. We designed a mechanism that automatically samples the signal transfer every few minutes and adjusts the tuning for optimum signal transfer. This added an important enhancement to the communications system.

In further developing the in-mine (IM) system we designed and built power supplies for the remote control modules and developed and designed two additional features:

1. Since the bandwidth of power-lines is relatively narrow in terms of communications needs, we designed and built two word compression units to allow wide-band information to be transmitted via narrow-band transmission lines, and

2. Interference between two or more network transmitting antennae in areas where transmission overlap occurs caused an unacceptable level of “squeaking” sound in the wireless radio of the receiving party. We traced the cause of the interference and removed the problem by adding corrective circuitry to the antenna modules.

RESULTS AND DISCUSSION

The project proceeded along the proposed work in the application for funding. Steps that were taken to enhance interference-free, clear wireless two-way communications were tested in the laboratory. The technology proved to meet our expectations. Additional work will be done to develop multi-channel capability for both voice and data transmission.

CONCLUSIONS

The objective of this project is to develop a mine-wide and through-the-earth two-way, real-time wireless communications technology for the underground mining industry. The development, design work, and tests that were conducted to date addressed voice communication. The test results lead us to conclude that the technology is feasible and that we shall meet expectations. Data transmission is in fact less complicated than voice transmission in this application. Therefore, we expect not to encounter insurmountable challenges to bring the project to a successful conclusion.