S51D-3267 A Deep Learning Model for DAS Anomaly Detection: Unveiling Microseismic Events with Autoencoders

Friday, 13 December 2024

08:30 - 12:20

Hall B-C (Poster Hall) (Convention Center)

Abstract

The longwall mining technique is engineered to maximize coal extraction by allowing controlled roof caving, which is expected to generate seismic activity. Detecting seismic events and gaining deeper insights into them can help mining engineers and geoscientists as they carry out mine safety and operations planning. This study uses a distributed acoustic sensing (DAS) system with a fire-safe fiber-optic cable installed underground in an active longwall coal mine. While DAS technology has lower sensitivity than conventional seismometers, it offers advantages such as dense sensor placement and proximity to the active mining face, where numerous microseismic events are expected. To automatically detect anomalies (candidate seismic events) within seven weeks of large-scale DAS data, we employ convolutional autoencoder deep-learning models to the multi-channel spectra of the data. Using the kernel density estimation (KDE) technique, we calculate a density score that acts as a threshold to distinguish between typical background noise and potential seismic events. The developed algorithm effectively separates data into ambient noise and the anomalies of interest, providing a robust tool for DAS data management at mines with limited computational resources. Integrating DAS monitoring with the developed deep learning model facilitates gaining valuable insights from densely deployed underground sensors near mining operations.

First Author

T

Ahmad Tourei

Colorado School of Mines

Authors

M

Eileen Martin

Colorado School of Mines

A

Alexander Ankamah

Virginia Polytechnic Institute and State University

H

John A Hole

Virginia Polytechnic Institute and State University

C

Derrick JA Chambers

Centers for Disease Control and Prevention

View Related