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Visualization of 1D CNN Lithology Identification Model from Rotary Percussion Drilling Vibration Signals Using Explainable Artificial Intelligence Grad-CAM

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In recent years deep learning has gained a lot of popularity because of its ability to work on complex tasks. It has been used in many industries to optimize operations and to help in decision-making. Deep neural networks have often been referred to as ‘Black boxes’, that is they take inputs and give outputs with high accuracies without giving an insight into how they work. It is important to demystify deep neural networks to verify that they are looking at the correct patterns. This paper proposes the use of Gradient-Weighted Class Activation Mapping (Grad-CAM) to visualize the behavior of lithology identification models that use drill vibrations as input to a one- dimensional convolutional neural network (1D CNN). The lithology identification models, time acceleration, and frequency model had 99.8% and 99.0% classification accuracy. The models could distinguish between granite and marble rock based on vibration signatures. With the use of Grad-CAM, it was possible to make the 1D CNN models transparent by visualizing the regions of input that were important for predictions. The Grad-CAM results indicated that the lithology identification models successfully learned the significant frequencies contained in each rock's vibration signal.

Keywords : lithology identification, convolutional neural network, gradient-weighted class activation mapping