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Damage detection in concrete structures with impedance data and machine learning

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Abstract
This study aims to evaluate the effectiveness of machine learning (ML) models in predicting concrete damage using electromechanical impedance (EMI) data. From numerous experimental evidence, the damaged mortar sample with surface-mounted piezoelectric (PZT) material connected to the EMI response was assessed. This work involved the different ML models to identify the accurate model for concrete damage detection using EMI data. Each model was evaluated with evaluation metrics with the prediction/true class and each class was classified into three levels for testing and trained data. Experimental findings indicate that as damage to the structure increases, the responsiveness of PZT decreases. Therefore, we examined the ability of ML models trained on existing experimental data to predict concrete damage using the EMI data. The current work successfully identified the approximately close ML models for predicting damage detection in mortar samples. The proposed ML models not only streamline the identification of key input parameters with models but also offer cost-saving benefits by reducing the need for multiple trials in experiments. Lastly, the results demonstrate the capability of the model to produce precise predictions. © 2024 The Author(s).

Author Keywords
concrete structures; damage; electromechanical impedance; machine learning; piezoelectric material

Index Keywords
Concrete buildings, Concrete construction, Concretes, Damage detection, Forecasting, Mortar, Piezoelectricity; Accurate modeling, Concrete damages, Damage, Electromechanical impedance, Experimental evidence, Impedance data, Impedance response, Machine learning models, Machine-learning, Surface-mounted; Machine learning

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