## DeepShap Explanation XAI of Using Fused Data of Damage Images and Vibration Signals in Structure Health Monitoring

## Saleh Al-Qudah, Mijia Yang

Department of Civil, Construction and Environmental Engineering, North Dakota State University, Fargo, ND 58104

## Abstract:

DeepSHAP, an advanced explainability method, has been employed to interpret the predictions of convolutional neural networks (CNNs) utilizing fused damage images and vibration data images as input for structural health monitoring (SHM). This fusion strategy integrates the spatial detail of damage images with the dynamic insights of vibration data, transformed into visual formats. While the fusion improves model performance in detecting and classifying structural damage, understanding the decision-making process of CNNs remains critical for trust and adoption in SHM applications. DeepSHAP offers an effective framework for identifying the key features and regions in the fused inputs that influence model predictions. By providing visual explanations and quantifying feature importance, DeepSHAP not only validates the enhanced performance of the fused data approach but also offers insights into the underlying structural behavior represented in the data. The study demonstrates that incorporating explainability through DeepSHAP ensures model transparency and reliability, fostering confidence in AI-driven SHM solutions.