Unsupervised Machine Learning of Acoustic Emission Signal During Crack Progression

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Abstract:

Acoustic emission is one of the various types of non-destructive testing (NDT) techniques that are used for structural damage identification. The purpose of this research is to investigate acoustic emission signals produced during crack propagation by Finite Element Analysis (FEA) codes. Specific types of signals are observed mainly Lamb waves. Therefore, signal features are established from the generated signals that are used in clustering analysis by the K-means algorithm using MATLAB program. In this study, a novel discovery on the distance between cluster's centroids expands the current understanding of the K-Means algorithm. This achievement offers a unique perspective on the correlation of clusters available to damage attributes. K-means is used for the calculation of distance between centroids of clusters that are available for different combined parameters such as root mean square and standard deviation of signal amplitudes. The output forms a new damage parameter for crack signal wave analysis. This parameter manipulates the relationship between the two distinct modes of signals hence several clusters are plotted, and their centroids' distances are compared.

Keywords:

Acoustic emission, Crack propagation, K-Means, Machine learning.