Sub-Surface Damage Detection Using Deep Learning Algorithm Based On Full-Field Strain Measurement

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Autonomous damage detection in structural systems has been gaining momentum with the advancements in computer vision and machine learning methods. Accurate damage detection and localization is essential since unchecked damage can cause structure to fail unexpectedly in an extreme event. There are several surface damage detection methods that present satisfactory performance, however, in case of sub-surface damage they may not have the same level of consistency. In this study, a deep learning algorithm based on convolutional neural network (CNN) is developed to localize sub-surface damage. The algorithm makes use of full-field strain measurements on the surface of the structure to localize the damage, since strain concentration is a good indicator of damage to a structure. The dataset is prepared artificially by finite element simulation of rectangular plate having a sub-surface damage. The sub-surface damage is of varied length, size, depth and direction of propagation. The dataset is broken into three parts to train, validate and test the CNN algorithm. The Intersection of Union score is found to be 0.79 for both training and testing set. This shows that the model can localize the damage with reasonable accuracy.