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PROCEEDINGS

Deep Learning-Based Prediction of Material Elastic Constants and Residual Stresses of Orthotropic Materials from Moiré Interferometry

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ABSTRACT

This work analyzes the problems of material elastic constants identification and residual stresses determination in an orthotropic materials using hole drilling method. These problems are very important to understand mechanical performance of materials. A lot of optical method such as Moiré, laser speckle interferometry, digital image correlation or photoelasticity is developed to estimate displacement (or strain) fields or applied loads (or stresses) from images. These methods require a very complicated techniques, skill, and efforts to analysis images. But deep learning method based on a convolution neural network shows better performance in image analysis problems such as object classification, detection, and segmentation than the other methods and it doesn't need human intervention which can make errors, so it can be autonomous procedure.

In this work, Moiré interferometry images are generated from the displacement field around hole in a stressed orthotropic plate with plane stress condition and they are used as dataset for deep learning model. This study aims to develop a novel convolution neural network based deep learning model for inverse analysis such as material elastic constants identification and residual stresses determination in orthotropic materials and it is compared with the benchmark model such as GoogLeNet and ResNet. It has significantly fewer parameters than benchmark model, but it shows same accurate prediction of mechanical properties and residual stresses of orthotropic materials.

KEYWORDS

Moiré interferometry; elastic constants; residual stresses; inverse problem; deep learning

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