AUTOMATIC SEGMENTATION AND IDENTIFICATION OF DEFECTS BY DEEP LEARNING ALGORITHMS FROM PULSED THERMOGRAPHY DATA

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Infrared thermography (IRT), is one of the most interesting techniques to identify different kinds of defects such as delamination and damage existing in materials. Raw thermal signatures, however, are usually noisy and require further processing to improve contrast and improve defect detection. Image segmentation algorithms have been widely applied in the image processing field, although very rarely in the IRT field. In this paper, the spatial deep learning algorithms for defects segmentation and identification are investigated. The obtained results are evaluated with the key evaluation metric, Probability of Detection (POD) from deep learning structural models such as Mask Region-based Convolutional Neural Networks (Mask-RCNN), U-net; Resnet-U-net; etc. The application of the state-of-the-art deep convolutional networks for automated detection and identification of defects by instance and semantic segmentation are presented using thermal data from Pulsed Thermography (PT). A series of academic samples made of different materials and containing artificial defects of different shapes and nature (flat-bottom holes, Teflon inserts) have been tested by PT and the results were studied in order to evaluate the efficacy and performance of the proposed algorithms. These methods also adapted regular data augmentation strategies for the thermographic images to precisely extract specific features for the defect regions based on the raw data for enriching and optimizing the training database. The detection results are very promising, which shows that deep learning models have the reliability required for the assessment of defects by automatic detection. Comparing with the preliminary experimental results among these methods, the instance segmentation Mask-RCNN is the most promising one for accuracy.