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ABSTRACT

PRESENTATION

PAPER

Marc Kreutzbruck is a professor and head of the Institute for Plastic Technology of the University of Stuttgart in Stuttgart, Germany. He is a specialist in the field of non-destructive testing procedures, process development for acoustic, electromagnetic, thermal and optical testing methods and also is Level 3 certified according to DIN EN ISO 9712 in the field of ultrasonic testing and magnetic particle testing. His area of interest covers the following: quality assurance for the production and operation of lightweight components and especially fiber-reinforced plastic composites, testing strategies for complex materials and components, sensor technology and measurement and testing technology, modeling and simulation of test procedures, strategies in signal processing and imaging, reconstruction algorithms and standardization in the field of non-destructive testing.

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DEFECT CHARACTERIZATION IN IR-THERMOGRAPHY USING CONVOLUTIONAL NEURAL NETWORKS

In most NDT methods, the inverse problem must be solved to identify a material defect. The measurement data should be used to draw conclusions about the underlying defect in the component in terms of defect size, defect location and defect depth. There are currently various approaches to improving imaging in active thermography. Artificial intelligence (AI) is one of them and represents a future solutions with great potential, which can support even inexperienced personnel in data evaluation and defect detection. Convolutional neural networks (CNN) are often used for this purpose to analyse thermograms. Among them the U-Net is a special network architecture based on CNNs. Cross-connections between the encoder and decoder side of the network allows for high mapping accuracy which even can be achieved with small training data sets. The encoder gradually reduces the input image to a minimum and extracts the relevant features. The subsequent decoder links the extracted features with each other and scales the information back to the original size using additional layers. This makes it possible to quickly and reliably recognize and segment impact damage in a small data set of lock-in thermographic phase images of CFRP. The recorded cooling curves are processed pixel by pixel and the depths and diameters of flat bottom holes in CFRP sheets are classified and quantified. The local component thickness up to the damage surface or the component thickness up to the back wall geometry is used as the output variable. This article demonstrates that a comparatively small data set consisting of just a few hundred training images is sufficient to precisely perform an automated evaluation of 2,5D geometries of the rear wall or of damage surfaces.