Non-destructive testing and evaluation of materials using active thermography and enhancement of signal to noise ratio through data fusion

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Abstract

Active thermography has emerged as an attractive and reliable technique for non-destructive testing and evaluation of a variety of materials, structures, and components due to its non-contact, whole-field, high speed and qualitative and quantitative inspection capabilities. However, the existence of non-uniform heating, low spatial resolution, and environmental noise cause some difficulties for defect detection and characterisation; demanding the necessity of various signal processing methods. Fourier transform has proved to be an effective method to extract amplitude and phase images from the recorded thermal sequences. Phase image has received extensive attention to the quantitative analysis, even though the amplitude image may contain useful information as well. Present work explores the possibility of enhancing the signal to noise ratio of inclusion defects in a GFRP composite sample through data fusion of amplitude and phase images as an innovative approach. Amplitude and phase images with several simulated inclusions of various shapes and sizes at different depth levels were considered. The well established and recognised pixel-level data fusion based on PCA and DWT techniques was performed and compared to detect and evaluate the inclusions.

Keywords:

Active thermography, Amplitude image, Phase image, Data fusion, Signal to noise ratio