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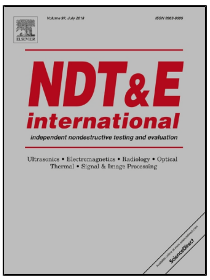

Image Processing based Quantitative Damage Evaluation in Composites with Long Pulse Thermography

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Image Processing based Quantitative Damage Evaluation in Composites with Long Pulse Thermography

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ABSTRACT

Pulsed thermography is a contactless and rapid non-destructive evaluation (NDE) technique that is widely used for the inspection of fibre reinforced plastic composites. However, pulsed thermography uses expensive and specialist equipment such high-energy flash lamps to generate heat into the sample, so that alternative thermal stimulation sources are needed. Long pulse thermography was recently developed as a cost-effective solution to enhance the defect detectability in composites by generating step-pulse heat into the test sample with inexpensive quartz halogen lamps and measuring the thermal response during the material cooling down. This paper provides a quantitative comparison of long pulse thermography with traditional pulsed thermography and step heating thermography in carbon fibre and glass fibre composites with flat-bottomed holes located at various depths. The three thermographic methods are processed with advanced thermal image algorithms such as absolute thermal contrast, thermographic signal reconstruction, phase Fourier analysis and principal component analysis in order to reduce thermal image artefacts. Experimental tests have shown that principal component analysis applied to long pulse thermography provides accurate imaging results over traditional pulsed thermography and step heating thermography. Hence, this inspection technique can be considered as an efficient and cost-effective thermographic method for low thermal conductivity and low thermal response rate materials.

Keywords: Long Pulse Thermography; Infrared Thermography; Principal Component Analysis;