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Data Analysis Techniques in Thermographic NDT of Composite: A Critical Comparison

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Abstract

Thermography is a relatively new and fast emerging area of inspection methodology in the field of non-destructive testing. This involves the use of an IR camera to capture the evolution of surface temperature profiles of the test object, after being subjected to thermal perturbation from a high energy uniform light source. In spite of serious drawbacks of poor penetration and low signal-to-noise ratio, the fast, contact-less and couplant-free inspection procedure involved in thermography have much promise in certain applications.

Thermal energy deposition is conventionally carried out in two ways, i.the pulse mode (pulse thermography) wherein the thermal energy is sent out in a burst ii.the standing wave mode (lock-in thermography) where the thermal waves are made to constantly impinge on the specimen. The ease and speed with which pulse thermography can be carried out, has much potential for its practical usage in the shop floor. However, visualizing the pulse as a combination of sinusoids, the specific advantages of lock-in thermography were later integrated into this much simpler technique in the form of 'pulse phase thermography'.

Much effort has been made by different researchers in this field towards developing appropriate data analysis techniques for overcoming high noise levels which are invariably present in thermal data. Vavilov, Grinzanto et al's normalized contrast (time domain) technique[1] and Maldague, Marinetti et al's pulse phase (frequency domain) technique[2,3] mark two major trends in this direction, each with its own claim of wide ranging applicability.

The present paper aims at making a critical comparison of the above two techniques, by applying them on an experimental situation where non-uniformity of the heat source and anisotropy of material thermal properties combine to create a typical adverse situation for thermographic NDT. Pulse thermography carried out with a conventional heat source, which invariably had a non-uniform radiation profile, a simple easy-to-use fixture, which further added to this non-uniformity and an anisotropic cfrp laminate, having rayon-based carbon fabric as reinforcement with porous phenolic resin as matrix, had been used for creating this truly adverse experimental situation.

Finally, an attempt has been made in this paper to assess the capability of each of these data analysis techniques for detection of defects embedded at different depths of the cfrp laminate, to weigh the pros and cons and then to chalk out a logical route for reliable defect detection in composites.

References

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