Advances in Applications of IR Imaging Techniques

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Abstract

Temperature is a significant parameter playing a key role in all spheres of human and universal activity. A temperature based non-destructive test method is Infrared or thermal imaging or thermography. Based on the detection of infrared radiation, this NDT method has evolved into a mature technique with a gamut of applications ranging from infrared astronomy to predictive condition management in industries, materials characterisation, surveillance and healthcare. Spanning a period of 15 years IR imaging has been successfully applied for solving a wide variety of problems and exploring many interesting applications at the Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam. This presentation provides a brief overview of some of the interesting applications in the areas of materials characterisation such as application of pulsed methods for detection of glue variations in adhesively bonded materials and detection of vascular disorders and breast lesions in the field of healthcare.

It is now well established that Artificial Neural Networks (ANN) can be used to solve complex non-linear classification and prediction problems. In thermal NDE, ANNs have been used in a very limited way, primarily for defect analysis and classification. In this presentation we also highlight the feasibility of using multi-layered perceptron based ANN for predicting the strain rate during tensile deformation of nuclear grade Type 316 Stainless Steel with prediction errors less than 2.7\%. This approach provides feasibility to interpolate and determine the stress or temperature based on minimum experiments and can also be applied to industrial components.

Though the techniques of lock in thermography is quite old, the technique is now finding increasing applications. The basic idea of lockin thermography is that the temperature modulation induced from the outside on the surface of the inspected component propagates as a "thermal wave". As this wave undergoes reflections at boundaries like all other waves, the temperature modulation at the surface is modified by thermal waves coming back from the inside of the component. By monitoring the modulated excitation signals and appropriate fourier transforms, information on defects can be obtained from the observed phase and amplitude of these waves. The phase image has the advantage that it is independent of local variations of illumination or of surface emissivity. This presentation would also highlight results of some interesting case studies being carried out in collaboration with Fraunhofer Institute of NDT (IZFP), Saarbrucken.