The contribution of Non Destructive Testing (NDT) techniques in industrial applications

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Abstract

Non Destructive Testing & Evaluation (NDT&E) techniques have been widely used in different engineering disciplines (i.e. aerospace, civil, mechanical etc.), due to their outstanding advantage of being able to determine the physical condition of an object without affecting its future usefulness. In other words, the general term of Non Destructive Testing (NDT) refers to the implementation of inspection technologies that can provide information without altering the test-piece in any way, and simultaneously determine the absence or presence of conditions and/or discontinuities, that may have an impact on its serviceability. All these techniques have a great impact on many industrial fields, as they can be applied for the quality control of a product during its design, manufacturing and maintenance stages. Aim of the present work is to demonstrate the applicability of Infrared Thermography and Ultrasound Testing techniques in three different case studies of industrial interest.

The first case study deals with the proposition of a robotized IR thermography system for the inspection of transport fibre reinforced composite structures. In thermographic surveys, the inspector uses the camera to acquire images from the examined part. Common problems are the lack of repeatability when trying to repeat the scanning process, the need to carry the equipment during scanning, and the long setting-up time. In order to overcome the above drawbacks, a prototype inspection system was deployed, under the framework of a collaborative project [1], with the capabilities of automatic scanning process, conduction of thermal NDT scanning on structures, creation of the appropriate scanning conditions (material thermal excitation), and ensure precision and tracking of the scanning process. A thermographic camera is used for the image acquisition of the non destructive inspection, which is installed on a x, y, z, linear manipulator's end effector and is surrounded by excitation sources (optical lamps), required for the application of transient thermography.

The second case study deals with the development of a prototype ultrasonic early detection system to inspect and diagnose the condition/integrity of creep susceptible high temperature/pressure boiler and steam pipe welds used in electricity generating power stations [2]. Creep is the time-dependent, thermally assisted deformation of a component operating under stress. Boiler tubing, headers, and steam piping in power plants might operate at thermal conditions conducive to causing creep damage over the operating life of the component. To ensure safe and reliable operation of such components, utilities periodically use Non Destructive Evaluation (NDE) techniques to inspect these components. Current status of inspections is largely targeted at detecting late stage creep damage in which cracking is active.

The third case study deals with the development of a field implementable system combining the capabilities of an advanced Non Destructive Inspection (NDI) technique, a flexible manipulating device for automated inspections and a novel methodology for incorporating NDT data into Damage Tolerance (DT) assessment [3]. In particular, high sensitivity ultrasonic Phased Array (PA) technology accompanied with a sophisticated defect detection software were developed to manually and/or automatically (through the aid of the manipulator) inspect composite aircraft structures and to detect small size flaws. Selected results from the PA inspection are used as inputs to perform online or semi-online DT assessment of damaged composite components. The assessment is processed through the aid of advanced numerical Finite Element Methods (FEM) in a computer. Eventually, the results from the PA technique as well as the results from the DT analysis after processing are available to the inspector in a simple Graphical User Interface (GUI).

References

1. http://www.compairproject.com/
2. http://www.creeptest.com/project-outline.jsp
3. https://www.youtube.com/watch?v=CgrSJUynrC8