ROBOTIC ULTRASONIC TESTING

Inspection of complex composite aircraft parts using phased array ultrasonic immersion techniques and single crystal dual frequency through transmission ultrasonic squirters

// NIGEL THORPE, MONTSERRAT ACEBES

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“THE INDUSTRY IS MOVING AWAY FROM LARGE GANTRY SYSTEMS TO THE MORE FLEXIBLE USE OF ROBOTICS”

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Changes in the construction materials of aeronautical structures have increased over the last 20 years, moving away from the use of aluminium alloys to the use of composite materials. These new components can, in some cases, have complex geometries which in turn need to be inspected non-destructively to ensure that during production they do not compromise the aircraft structure and are defect free.

Furthermore, the industry is moving away from large gantry systems to the more flexible use of robotics. The use of robots allows for the exchange of inspection systems and configurations to suit each type of component, adapting the system to be able to inspect not only simple components but also those with complex geometries. These systems can use of several transducers for specific inspection, using complex electronics but culminating in a user-friendly inspection system.

Tecnitest Ingenieros were contracted to provide an immersion system that had the capability to fulfil the inspection of relatively simple and complex components using Phased Array Ultrasonic (PAUT) Immersion techniques and single crystal through transmission squirters. The system was built in collaboration with Aciturri Aeronáutica and Caetano Aeronautic along with Dasel UT systems.

1 // The immersion system supplied can inspect both simple and complex components

SYSTEM DESCRIPTION

The system comprises of an immersion tank, a robot, the relevant ultrasonic transducers and ultrasonic cards and a work station with the relevant software to display; ‘A’, ‘B’ and ‘C’ Scan images of the inspection.

The project was split into three different phases. Phase one provides a system for the inspection of components placed in the immersion tank. This uses a 32 element 5MHz phased array probe and also, where necessary, has the possibly of using a gimbal to follow the contours of the components using a single crystal transducer.

Phase two provides a system for the inspection of a curved complex components, covering all surfaces in one pass, using the same immersion tank and robot as in phase one, but with up to seven 5MHz 128 element phased array transducers.

Phase three provides a system for the inspection of components using a single crystal through transmission system, again using the same immersion tank and the same robot as in the first two phases.

2 // The system is operated away from the inspection area for safety reasons

3 // The robot is mounted on a track for phases of the test

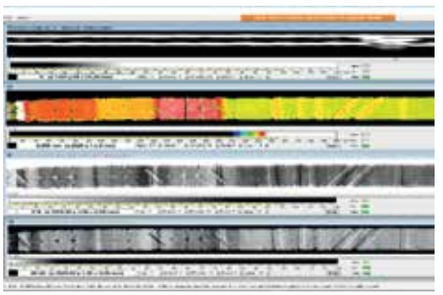
INITIAL WORK

Before any installation could be carried out at the customer site an installation was built at the facilities of Tecnitest. Whilst the immersion tank would not be the same size of that at the customer site, the inspection system was built to accommodate all three phases of the project and includes a robot on a track. This allowed the Tecnitest engineers to program the robotics and prove all of the inspection techniques before transfer to the customer site. This configuration also allows the customer to agree to the configuration before installation on site.

At the customer site the installation of the immersion tank, which is 10m long by 2m wide and has a depth of 637mm, has to have its height reduced by 92mm because of the installation of a glass plate that is used for reflective purposes, and the robot, that is positioned on a track cover the whole of the inspection surface of the tank. The operator’s station is located out of the inspection area and specific laser safety devices are used to stop all movement should anyone inadvertently enter the inspection area.

PHASE ONE

Phase one involves the inspection of parts laid on a holder in the bottom of the tank. Using a 32 element phased array probe at 5MHz, in double through transmission using the glass in the bottom of the tank as a reflector. Furthermore, the system in this phase has the possibility of using a specifically designed probe holder with a gimbal arrangement and a single crystal transducer ensuring that transducer is always perpendicular to the surface of curved component.



"A QUICK AND AUTOMATED INTERCHANGEABLE SYSTEM ALLOWS USING SPECIFIC INSPECTION HEADS FOR EACH COMPONENT"

PHASE TWO

The second phase was much more complicated than phase 1 and involved the inspection of curved components with many faces in one pass.

The tank is used and the pieces with complex geometry (eg omegas type) are placed on an ad-hoc hoding (previously designed for this use) immersed in the tank. As the transducer holder passes along the component, the jaws holding the component open automatically to allow the transducer to pass and close after passing.

Phase two allows the use of up to seven 128 element phased array transducers in a specifically designed transducer carriage.

PHASE THREE

The third phase is based on the use of TT inspection mode using a single-transducer dual-frequency with water and SOCOMATE technology. It allows inspecting sandwich components, both flat and with complex geometry using a transmission tool.

The tool incorporates the yoke that carries the through transmission squirter system with the transducers. Again the yoke with the squirter system is collected from the changing station.

The pieces are placed following an axis, the inspections can be done by means of a single scan, when the geometry is slightly curved, or when more complex geometries may be necessary to program a trajectory for each piece. Trajectories are optimized for each component ensuring a collision-free operation

So far two dual frequency ultrasound probes have been used for transmission in water, but the development can be extended to an in-air inspection system. \\

Nigel Thorpe is a technical consultant at Tecnitest and M. Acebes is research and development director at Tecnitest

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NDT INSPECTION SYSTEMS UNDER ONE ROOF

Tecnitest Ingenieros is a non-destructive testing engineering company developing and marketing the most efficient solutions to particular inspection needs.
Tecnitest activity addresses all industrial sectors and comprises all NDT methods, paying special attention to the use of advance technologies and innovation with a clearly defined goal: optimisation of inspection cost, time and reliability.
This activity includes the distribution of a complete range of NDT equipment and accessories, level 3 services and technical advice, training in NDT and development of non-destructive inspection systems.
At Tecnitest NDT, we have our design, manufacture, sales and aftercare teams all under one room, therefore allowing us to offer a full and inclusive service from application query to execution and beyond.
As well as having all our team under one roof, Tecnitest NDT is made up of highly skilled, NDT trained personnel.

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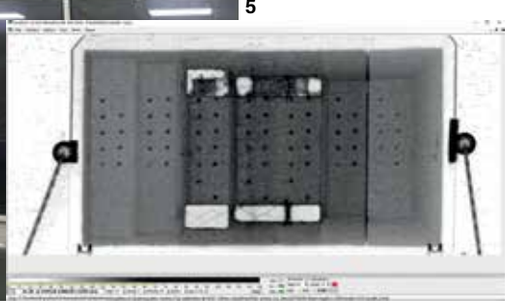

4 // With up to 896 ultrasonic channels, the machine is designed to inspect the complex geometry components in one pass, which guarantees the minimum possible inspection time

5 // Process of inspection for sandwich components