Flexible Integration of Robotics, Ultrasonics and Metrology for the Inspection of Aerospace Components

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The performance of modern robotic manipulators has allowed research in recent years, for the development of fast automated non-destructive testing (NDT) of complex geometries. Contemporary robots are well suited for their accuracy and flexibility when adapting to new tasks. Several robotic inspection prototype systems and a number of commercial products have been created around the world.

This paper describes the latest progress of a new phase of the research applied to a composite aerospace component of size 1 by 3 metres. A multi robot flexible inspection cell was used to take the fundamental research and the feasibility studies to higher technology readiness levels, all set for future industrial exploitation. The robot cell was equipped with high accuracy and high payload robots, mounted on 7 metre tracks, and an external rotary axis.

A robotically delivered photogrammetry technique was first used to assess the position of the components placed within the robot working envelope and their deviation to CAD. Offline programming was used to generate a scan path for phased array ultrasonics testing (PAUT) which was implemented using high data rate acquisition from a conformable wheel probe.

Real-time robot path-correction, based on force-torque control (FTC), was deployed to achieve the optimum ultrasonic coupling and repeatable data quality. New communication software was developed that enabled the simultaneous control of the multiple robots performing different tasks and the reception of accurate positional feedback positions. All aspects of the system were controlled through a purposely developed graphic user interface that enabled the flexible use of the unique set of hardware resources, the data acquisition, visualisation and analysis.

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