AFRC

ADVANCED FORMING RESEARCH CENTRE

UNIVERSITY OF STRATHCLYDE

University of Strathclyde Glasgow

Advanced Forming Research Centre

Spirit AeroSystems (Europe) Ltd

Project Background

Demand for advanced aerospace inspection systems is expected to grow significantly over the next two decades with 32,000 new commercial aircraft set to be delivered by 2036.

This surge in manufacturing activity has led to an upswing in the need for cost-effective and efficient non-destructive evaluation (NDE) and testing of both the complex geometry and composition of advanced composite components prior to operational service.

The VIEWS project: 'Validation and Integration of Manufacturing Enablers for Future Wing Structures' involved the AFRC in collaboration with Spirit AeroSystems, the Centre for Ultrasonic Engineering at the University of Strathclyde, and other partners. Together, they developed a novel and truly flexible automation facility which combines conventional metrology processes and NDE techniques in a first-of-its kind robot cell.

By integrating three traditionally separate processes: robotics, metrology and non-destructive testing into a single common framework, which encompasses both hard and software, the team established a new paradigm for inspection automation.

The deployment of this technology potentially will begin with wing structures having a global value in excess of US$20 billion per annum. The project clearly demonstrated that the robotics cell can save valuable production time, help to reduce cost whilst maintaining quality, and drive down inspection cycle-time.

Problem

At present, the inspection rates for metrology and non-destructive testing (NDT) operations are very dependent on the specific part and geometry.

Typical current measurement times being implemented on separate inspection systems, may run to five square metres per hour. Increased production invariably leads to the need for higher rates of productivity which could potentially more than double over the next ten years to 100 ship sets per month.

To meet such demanding requirements, pulse times across the entire operation will need to be reduced which includes quality and inspection. Thus, this project has an important part to play in providing Spirit AeroSystems with platform technologies that are rate capable.

Shaping the future
Forging partnerships

CATAPULT High Value Manufacturing

What we did

Following the development of an initial demonstrator, the AFRC and its partners produced a full size, flexible inspection automation facility which provides the capability to pursue both research and industrially facing knowledge exchange in a single location.

Working closely with KUKA Robotics UK during the initial robot cell design and commissioning phase, allowed an unprecedented level of flexibility and future proofing to be built into the cell to accommodate the widest possible range of future applications.

The current cell comprises three high accuracy KUKA Quantec series robots that are configured to operate independently or co-operatively depending on application demand.

The project recognised that a unified approach to robot control based on CAD/CAM was required to be fundamentally integrated into a software environment that can also accommodate the metrology and NDT data streams. Furthermore, this software must accommodate clear feedback to the operator to flag suspect areas of the structure being inspected. The key to driving the commercial goals of reducing cycle-time and cost are inextricably bound into the development of an efficient and intuitive user interface.

To achieve this goal, the project required extremely close technical collaboration between the partners to understand the subtleties of advanced robot control, precision subsystem synchronisation, and high speed data transfer, processing and visualisation.

> "This project has allowed us to take academic research that would traditionally sit at the low end of the TRL scale within the confines of a university and implement it in an industrial scale environment to help benefit our manufacturing process. Centres such as the AFRC are vital to bridging the gap between academic research and industry: this project shows the benefits of doing exactly that."
>
> David Watson, Senior Manager at Spirit AeroSystems (Europe) Advanced Technology Centre

Result

The collaboration to develop a truly flexible automation facility at the AFRC clearly represents a significant technological shift in manufacturing inspection.

Specific project collaboration goals to drive reduced cycle-time in complex geometry inspection have been proven. The current performance of the flexible automation cell is such that metrology at a rate of 15 square metres per hour, and NDT at a rate of 40 square metres per hour is possible, and this is in a single fixture component cell. For a six square metre part, this implies a reduction in overall inspection time from 2.4 hours to around 50 minutes, a reduction of 60%. This discounts additional time to transfer the part from metrology to NDT inspection cell in existing processes.

60% reduction in inspection time

The flexible automation cell is now a centrepiece of the AFRC workshop space, and represents the culmination of many years of close collaboration between academics, industrial end users, supply chain companies and various funding bodies.

The partnership is continuing to work together throughout 2017 to develop new high technology automated manufacturing solutions that feed directly into the competitive aerospace transportation sector in the UK. This will involve industrial trials at the AFRC towards the development of the commercial application of the technology. Secondly, the AFRC will pursue additional fundamental research on novel new research concepts such as advanced robotic control strategies and enhanced ultrasonic inspection procedures.

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