National Nuclear Laboratory

December 2010, Issue Number 1

NNL RCNDE Newsletter

INTRODUCTION

The NNL is a member of the Research Centre for Non Destructive Evaluation (RCNDE) on behalf of the Nuclear Decommissioning Authority (NDA).

The RCNDE formed in 2003 is an EPSRC (Engineering and Physical Sciences Research Council) sponsored collaboration between industry and academia to coordinate research into NDE technologies, and to ensure research topics are relevant to the medium to longer-term needs of industry. There are currently 15 full industrial members who tend to be organisations where NDT plays an important role from the nuclear, oil & gas, power generation and aerospace sectors.

The Centre recognises that the NDE supply chain is a vital element for successfully transferring technological advances arising from university research to their eventual practical application in industry.

The Centre involves all parts of the NDE supply chain through associate membership, particularly SMEs (Small to Medium Enterprises) and larger organisations offering training, consultancy, field services and hardware. There are currently approximately 20 associate members.

Focus on the Imperial College NDT Group

Guided wave inspection offers significant time and cost savings for inspecting lengthy pipe runs

The Imperial College NDT Group is led by Professors Peter Cawley and Mike Lowe. The group is particularly well known for the development of long range guided wave inspection. Conventional NDT techniques such as standard ultrasonic testing only interrogate the part of the test structure directly beneath the transducer. If the structure under inspection is large, this results in costly and lengthy inspections. One way to overcome this problem is to use guided waves which propagate along a structure and can interrogate the entire volume of the material along the propagation length. This is usually done in a "pulse-echo" configuration in which a transducer sends out signals and then detects reflections returning from defects; this can be used to inspect lengths of 100m or more from a single location. Alternatively, a "pitch-catch" configuration can be used to inspect the region between two transducers placed a distance apart. Thus, guided waves achieve a very good coverage as well as large savings in inspection time.

Guided Ultrasonics Ltd (GUL) (http://www.guided-ultrasonics.com/) was formed in 1999 to commercialise guided wave technology from the Imperial NDT Group. The Wavemaker Pipe Screening system was the first major product offered by GUL. The technology incorporated in the Wavemaker builds upon the work carried out on long range guided waves at Imperial.

The current system is designed for use on above-ground exposed or insulated pipes and short buried sections such as road crossings; only very limited pipe lengths can be inspected when the pipe is heavily coated in a very attenuative material such as bitumen or if it is encased in, for example, concrete. This is due to leakage of energy from the pipe into the surrounding medium. Current work in the group is looking at ways to overcome these problems.

Focus on the Imperial College NDT Group

The NNL and its predecessors have a history, on behalf of the NDA, of collaboration with the Imperial Group. BNFL was an industrial partner on the EPSRC funded project 'On-line measurement of pipeline contents using ultrasonic guided waves'. This demonstrated that certain modes of mechanical wave guided along the pipe wall are sensitive to the state of the contents of the pipe and could be used to detect pipe blockages and to measure the viscosity or density of the pipe contents.

More recently the NNL was an industrial partner on the recently completed EPSRC funded project 'Detection of cracks and corrosion using feature-guided waves'. The project included the development of a model to study and understand the nature of guided waves in welds and other structural features. This was followed by a study of the application of the model to butt welds and other realistic features of interest to the industrial partners; the NNL and Shell.

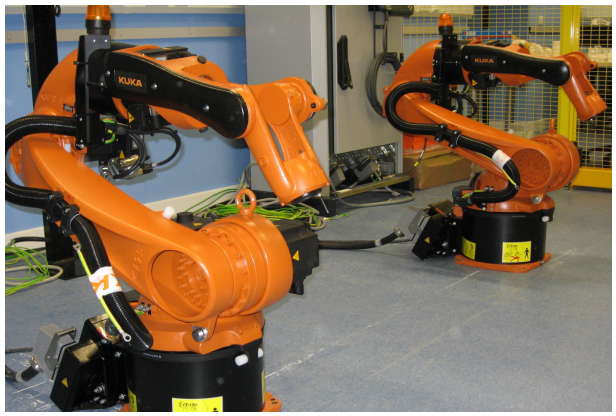
GUL Wavemaker 3 system: inflatable ring with transducers is fitted to the pipe connects to the sampling electronics which are connected to a PC

New FIRST Laboratory at Strathclyde

The University of Strathclyde is one of the founding academic members of the RCNDE. Recently a new laboratory, the Facility for Innovation and Research in Structural Testing (FIRST) has been established within the Centre for Ultrasonic Engineering (CUE). Assisted by an EPSRC equipment grant, the FIRST laboratory is customised for ultrasonic NDE imaging.

The equipment includes state of the art array control systems for real time ultrasonic imaging of welded joints in pipelines and other structures, a scanning acoustic microscope for NDE of micro-miniature components, robotic positioning systems for NDE of complex geometrical structures including aircraft and nuclear installations and state of the art magnetic imaging systems for testing of materials.

The intention is that CUE staff will conduct world leading research within FIRST and will be well positioned to take advantage of any potential commercial opportunities, thereby reducing the time for effective technology transfer from the research base. In addition the facility is available to external organisations to access the equipment suite for evaluation of technology and product testing.



FIRST Lab: 6 axis kuka robotic arms

National Nuclear Laboratory

New Targeted Research Project

The EPSRC announced in November 2010 that the RCNDE targeted research project proposal "New Methods for the Ultrasonic NDE of Difficult Materials" has successfully received funding. This project is led by the University of Strathclyde with academic partners the University of Manchester and industrial support from the National Nuclear Laboratory, Rolls-Royce, Serco and Shell. The proposal targets a single theme which is prevalent across a range of industries with a range of problems – the need to locate and identify defects within media which presents difficulties for ultrasonic wave propagation. Examples include austenitic steels, concrete and a variety of composite materials, where their heterogeneous nature limits the applicability of traditional methods of ultrasonic NDE imaging.

The project will investigate a range of methods for the ultrasonic NDE of difficult materials involving a combination of modelling, novel transducer design and array signal processing. The researchers are keen to focus the research on applications identified as priority areas by the industrial partners. If you have an NDE application which would benefit from this work please contact Gary Bolton at the NNL.

Thermography Seminar

Prof. Darryl Almond hosted a seminar on Thermographic NDE at the University of Bath on 24th November 2010. In conventional flash thermography, the surface of the test piece is heated by a short duration and high intensity flash. Under normal conditions, the part cools after flash heating, as the heat deposited at the surface flows toward the cooler interior. However, internal anomalies in the test piece, such as voids, inclusions, delamination, moisture, or changes in thickness or density, cause changes in the cooling rate at the surface. An IR camera is used to view images of the test piece surface as a continuous movie or at various times during the cooling sequence.

The University of Bath has developed three novel thermography techniques during the latest RCNDE core research programme; Thermosonics, Laser Spot/Line Thermography and Pulsed Eddy Current Thermography. Thermosonics uses a pulse of high power ultrasound in the 20-100 kHz range applied at one point on the test structure to generate a high frequency vibration field in the structure. This causes the surfaces of any cracks present to rub together, so dissipating energy which causes a transient temperature rise local to the crack which is detected by an IR camera. Laser Spot Thermography uses a laser for the heat source which traverses the sample. Defects, such as cracks, affect the flow of heat from the laser spot and these changes can be detected by an IR camera to form a defect image.

Laser Line Thermography is a further variant in which the laser is focused to form a line and this substantially reduces scanning times. Pulsed Eddy Current Thermography images the effects that defects within a structure have on the heating of a component produced by a pulsed eddy current heating system.

The three techniques have sensitivities similar to Dye Pentrant Imaging (DPI), Magnetic Penetrant Imaging (MPI) and eddy current inspection and are suitable for the detection of the same surface and near surface defects associated with these established methods. Their advantages are that they are very rapid inspection techniques, requiring little or no test piece preparation and none of the undesirable chemicals or UV light exposure associated with DPI and MPI. They all output digital image data that can be readily retained and archived and they require little operator expertise in testing or image interpretation. Thermosonics and pulsed eddy current thermography have been shown to image cracks under thick (~0.5 mm) coatings. Laser spot/line thermography is suitable for remote deployment.

All three techniques have been demonstrated in the laboratory on industrial samples and are at the Technology Readiness Level 3-4. Researchers at the University of Bath are looking for industrial applications suitable to these techniques and technology transfer routes to further develop the technology. If you have an NDE application which would benefit from this work please contact Gary Bolton at the NNL.

Future Meetings

31st January 2011	- RCNDE Technology Transfer Event, London
1st February 2011	- RCNDE Board Meeting, London
2nd February 2011	- RCNDE Industrial Working Group University visit, Imperial College
10-12th May 2011	- RCNDE Annual Reviews and Board Meeting, Stratford upon Avon

Further Information: If you require further information on any of the articles in this newsletter or any aspect of the RCNDE please contact: Gary Bolton, Direct: 01925 289856, Email: gary.bolton@nnl.co.uk

Winner
RESEARCH & DEVELOPMENT
Sector Award

Winner 2004 - 2008, 2010
Highly Commended 2009

www.nnl.co.uk

National Nuclear Laboratory
5th Floor
Chadwick House
Warrington Road
Birchwood Park
Warrington
WA3 6AE

T: +44 (0)1925 289800
E: customers@nnl.co.uk