Issue 10 - February 2015

NATIONAL NUCLEAR LABORATORY

RCNDE News

Research Centre for Non Destructive Evaluation

Welcome to Issue 10 of the NNL RCNDE Newsletter which is distributed to NNL's RCNDE network across the NDA estate. NNL is a proud member of the Research Centre for Non Destructive Evaluation (RCNDE) on behalf of the 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 and longer-term needs of industry.

Funding was secured in 2014 to continue RCNDE for a further six year period covering 2014 to 2020.

More information on the RCNDE is available at www.rcnde.ac.uk.

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Industrial Membership

The RCNDE funding model provides approximate matched EPSRC funding from the industrial membership including a significant cash contribution from membership fees. There are two categories of membership; full and associate. Full members tend to be large organisations where NDE plays an important role. Full membership provides those organisations with membership of the RCNDE Management Board (which meets three times each year) and the ability to steer the research to meet their strategic objectives and longer-term requirements. The current full industrial members of RCNDE are:

Airbus

AMEC

BAE Systems

BP

Defence Science and Technology Laboratory

EDF Energy

E.On

GKN

Hitachi Europe

NNL (on behalf of NDA)

Office for Nuclear Regulation

Petrobras

Rolls-Royce

RWE Npower

Shell

SKF

Tenaris

The RCNDE recognises that the NDT supply chain is a vital element for successfully transferring technological advances arising from university research to their eventual practical application in industry. Associate membership is aimed at these organisations with a tiered membership fee to attract Small to Medium Enterprises. Associate membership offers opportunities to network with major NDE end users and other suppliers, receive early technical information about the research, be invited to join nearer-to-market 'targeted' research projects and benefit from early notification of technology licensing opportunities. The current associate members of RCNDE are:

Alba Ultrasound

British Institute of NDT

Doosan Power Systems

Eddyfi

EPRI

Ether NDT

GE Inspection

Guided Ultrasonics

Inspectahire

KANDE International

Lavender International

Nuclear AMRC

Olympus

Peak NDT

Permansense

Phoenix Inspection

Systems

Renishaw

Silverwing

Sonatest

Sonemat

Sonomatic

Sonovation Holding

Sound Mathematics

Southside Thermal Sciences

Tribosonics

TWI

Ultrasonic Sciences

Vibrant NDT

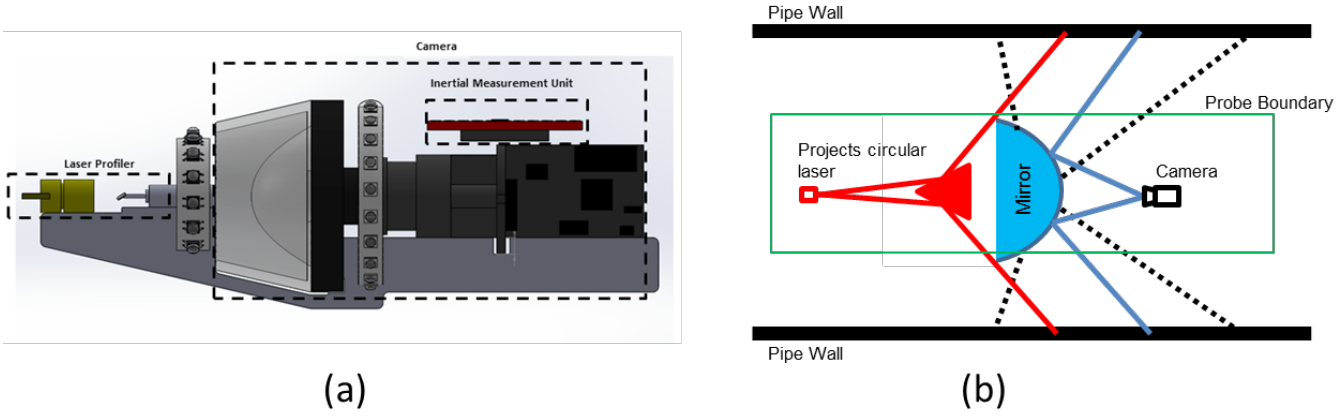
Weidlinger Associates

Zetec

The total cash contribution from membership fees budgeted for 2014/15 is in excess of £600K demonstrating the commitment of all these organisations to NDT research within the UK.

Innovate UK Success

Innovate UK (formerly TSB) announced the successful projects under their call "Developing the Civil Nuclear Supply Chain" in August 2014. One such project involves a consortium comprising National Nuclear Laboratory, University of Strathclyde, Inspectahire Instrument Company Ltd, Wideblue Ltd and Sellafield Ltd. The Collaborative Research and Development (CR&D) project, led by NNL, aims to build on a successful "Mosaicing for Automatic Pipe Scanning (MAPS)" TSB Feasibility Study that confirmed the feasibility of a novel approach to combining optical hardware and advanced image processing techniques for interactive 3D remote visual inspection (RVI) of pipe work in the nuclear industry.



Above: *(a) Schematic of video probe developed during feasibility study (b) Plan view of probe inside pipe with camera field of view shown by dotted lines*

The 3 year project is due to commence in April 2015 and aims to progress from this feasibility study to a ruggedized prototype which will be deployed and demonstrated in a range of test environments, both in the laboratory and on-site in a nuclear environment

Future Events

20th April 2015 – RCNDE Industrial Working Group, University of Manchester

21st April 2015 – RCNDE EngD Research Day, Manchester Conference Centre

22nd April 2015 – RCNDE Annual Research Day, Manchester Conference Centre

23rd April 2015 – RCNDE Management Board Meeting, Manchester Conference Centre

8-10th September 2015 – Materials Testing 2015, The International Centre, Telford

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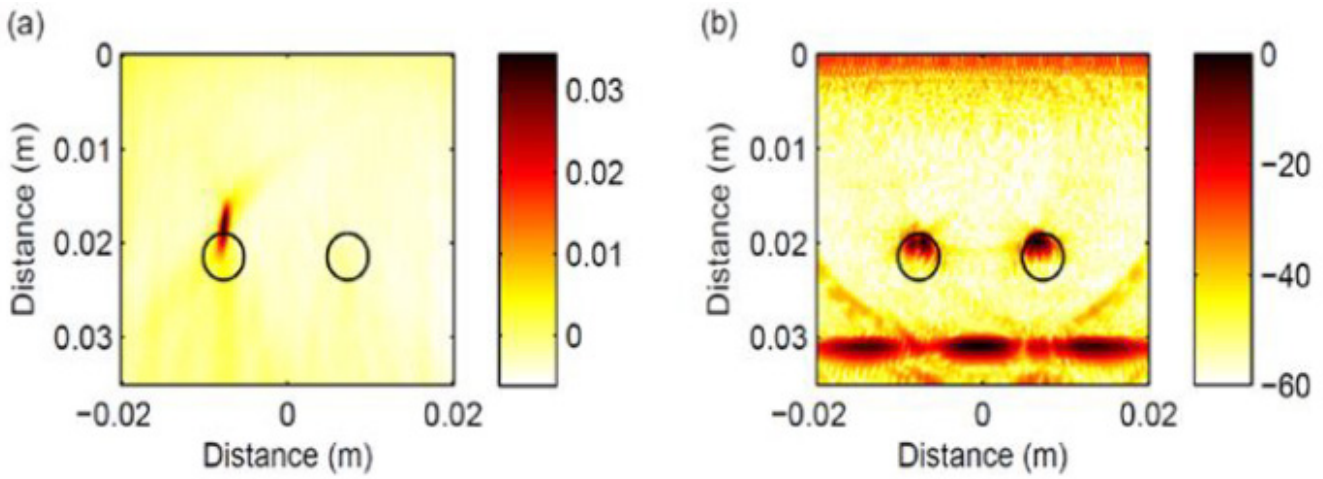
Advances in Non-linear Ultrasonic Imaging

Most traditional NDE techniques for damage detection are based on linear elastodynamic theory and rely on measuring the reflection and scattering of primary waves at the material heterogeneities and discontinuities. The presence of defects changes the phase or amplitude of the measured signal, but the frequency of the input waveforms remains the same. Although these techniques work well in the presence of a significant impedance contrast, when the impedance mismatch is less pronounced, for example, micro-damage, non-linear effects lead to transformation of some of the incident energy into frequency harmonics. In principle, imaging of the nonlinear waveforms can provide information about a range of material properties such as early stage fatigue damage.

Several RCNDE projects have investigated the potential of non-linear imaging through modelling and experimental work. Recent work at Bristol has looked in particular at imaging defects in the presence of geometric features (eg fastener holes), for which the non-linear response can be significant due to contact-acoustic non-linearity, localised plasticity and friction. This is a technique of enormous potential benefit, capable of imaging defects transparent to conventional linear acoustic techniques or where defect signals are swamped by signals from the geometrical features as illustrated below.

Imaging a fatigue crack growing from a fastener hole. The non-linear image (a) clearly shows the crack growing from the left hole with the holes themselves invisible to the non-linear image, while the crack signal in a conventional image (b) is swamped by geometric reflections.



This work was published in the distinguished journal, Physical Review Letters, in October 2014.

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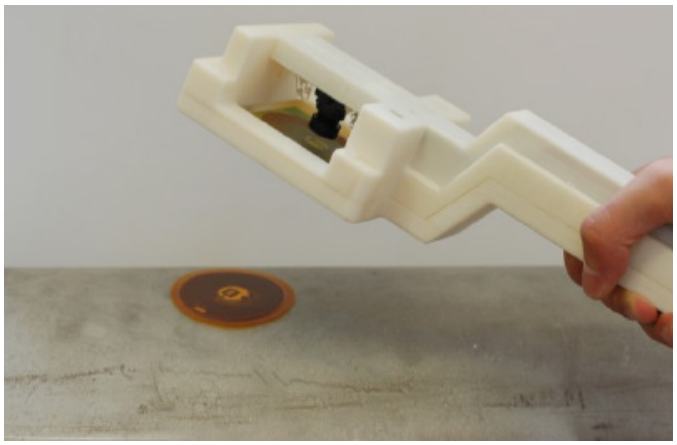
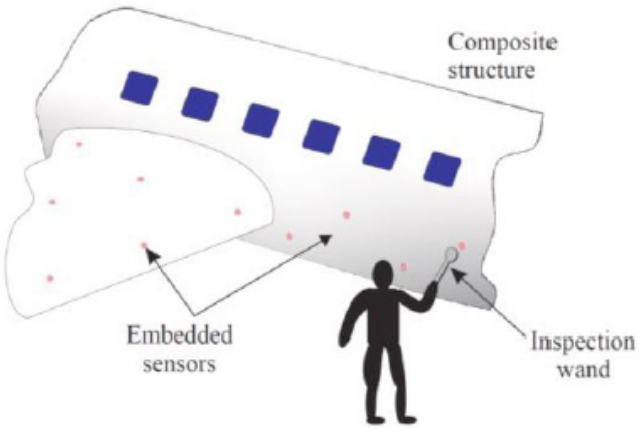
Inductosense: Wireless Embedded Sensor

Researchers at the University of Bristol have developed a novel NDT system that utilises permanent ultrasonic transducers attached to, or embedded into, a structure. The transducers are passive and the power and signal is provided by non-contact electromagnetic coupling between three coils; one of the coils is physically connected to the transducer, the other two are in a separate measurement probe, where they are connected to the transmit and receive channels of the instrumentation. There is no need for accurate alignment or coupling fluid, as with other NDT techniques. The sensor is fixed and so there is no human error in measurements where an exact location needs to be measured repeatedly over a protracted period. This enables an operator to undertake sophisticated and auditable NDT and for measurements to be made robotically by unmanned vehicles (eg for measurement on process plant and components in in accessible locations). The sensors are wireless which alleviates problems with complex wiring adding additional weight and lowering robustness. Sensors can be placed in areas that are usually inaccessible or even embedded into a structure. The inductive coupling system can also be designed with other types of sensor.





The system was developed over several years by the Ultrasonics and NDT research group at the University of Bristol. The University is currently evaluating the commercialisation opportunities for this technology.

The key benefits of the technology include:

- Light and thin sensor that can be embedded, put under coating or in difficult to reach places
- Passive sensor, battery-free wireless sensing
- Low cost
- Sensors can be fixed to the structure, no need for accurate alignment and repeatable

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Further Information

For back issues of the RCNDE newsletter, please visit www.nnl.co.uk/rcnde. If you require further information on any of the articles in this newsletter or any aspect of the RCNDE please contact:

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