

Fourth Training Event of NDTonAIR: *Sensor Design and Data-Acquisition Systems*

Workshop on Innovative Sensors for NDT and SHM -
Meeting with Scholars and Students Funded By China
Scholarship Council

25-28 September 2018

*Event Venue: Merz Court, Newcastle University,
Newcastle Upon Tyne, NE1 7RU, UK*

Agenda

Tuesday 25th

| Time | Contents | | Venue |
|-------------|---|------------------------|------------------------------|
| 9:30-9:45 | Welcome by Prof. G. Y. Tian | | Buttery, Merz court |
| 9:45-10:45 | Prof. G. Y. Tian Sensor Design and Applications | | |
| 10:45-11:00 | Tea/Coffee break | | |
| 11:00-12:30 | Lab tour Sensors and NDT Lab | | Sensor lab & Chamber room |
| 12:30-13:30 | Lunch & Break | | |
| 13:30-13:45 | ESR Presentations Part 1 | Micheal Stamm | Buttery, Merz court |
| 13:45-14:00 | | Housseem Chebbi | |
| 14:00-14:15 | | Yongtak Kim | |
| 14:15-14:30 | | Jaishree Vyas | |
| 14:30-14:45 | | Sevilia Sunetchiieva | |
| 14:45-15:00 | | Abdoulaye BA | |
| 15:00-15:15 | | Qiuji Yi | |
| 15:15-15:25 | Tea/Coffee break | | |
| 15:25-15:40 | ESR Presentations Part 2 | Hamed Malekmohammadi | |
| 15:40-15:55 | | Luca Pecoriello | |
| 15:55-16:10 | | Akram Zitoun | |
| 16:10-16:25 | | Silvio Amato | |
| 16:25-16:40 | | Muhammed Khalid Rizwan | |
| 16:40-16:55 | | Bengisu Yilmaz | |
| 16:55-17:10 | | Sergey Gartsev | |
| 17:10-17:25 | | Tommaso Seresini | |

Wednesday 26th

| Time | Contents | Venue |
|--------------|--|---------------------|
| 9:30-11:00 | Dr. Helge Pfeiffer Highly-nonlinear sensing devices in aeronautics and engineering (Part 1) | L301, Merz court |
| 11:00-11:15 | Tea/Coffee break | |
| 11:15-12:30 | Dr. Helge Pfeiffer Highly-nonlinear sensing devices in aeronautics and engineering (Part 2) | |
| 12:30-13:30 | Lunch & Break | |
| 13:30 -13:45 | Chaoqing Tang Compressed sensing and NDT&E | L301, Merz court |
| 13:45-14:00 | Ruslee Sutthaweekul Microwave NDT&E of BVID on woven carbon composites | |
| 14:00-14:15 | Adi Marindra Chipless RFID Sensor for SHM | |
| 14:15-14:30 | Junzhen Zhu Detection and Reconstruction of Rolling Contact Fatigue Cracks Using Eddy Current Pulsed Thermography | |
| 14:30-15:20 | Prof. Robert Smith Advanced UT for Composite | |
| 15:20-15:30 | Tea/Coffee break | |
| 15:30-16:20 | Prof. Robert Smith NDT for structural integrity and airworthiness of composite aircraft | |
| 16:20-17:00 | Discussion and questions | |

Thursday 27th

| Time | Contents | Venue |
|-------------|--|---|
| 9:30-11:00 | Prof Elena Jasiuniene Ultrasonic sensors (Part 1) | Buttery, Merz court |
| 11:00-11:15 | Tea/Coffee break | |
| 11:15-12:30 | Prof Elena Jasiuniene Ultrasonic sensors (Part 2) | |
| 12:30-13:30 | Lunch & Break | |
| 13:30-14:30 | Dr. Francesco Ciampa Advanced Non-destructive Inspection and Structural Health Monitoring of Aerospace Components | Buttery, Merz court |
| 14:30-15:30 | Sensors and NDT R&D in Newcastle Workshop on Innovative Sensors for NDT and SHM: Hands-on experience in the labs | ESR1-ESR7: Sensor lab ESR8-ESR15: Chamber room |
| 16:30-17:30 | Visit of Baltic centre of Contemporary art | Baltic Centre of Contemporary Art |
| 18:30-20:30 | Dinner at Pitch & Piano | Quayside |

Friday 28th

| Time | Contents | Venue |
|-------------|---|---|
| 9:30-11:00 | Prof. Marco Ricci General Assembly | Buttery, Merz court |
| 11:00-11:30 | Tea/Coffee break | |
| 11:30-12:30 | Prof. Anthony Peyton Electromagnetic sensing and imaging techniques | |
| 12:30-13:30 | Lunch & Break | |
| 13:30-15:30 | Workshop on Innovative Sensors for NDT and SHM: Hands-on experience in the labs | ESR1-ESR7: Chamber room ESR8-ESR15: Sensor lab |
| 15:30-17:00 | Preparations for European Researchers' Night | Great North Museum |
| 18:00-22:00 | European Researchers' Night | |

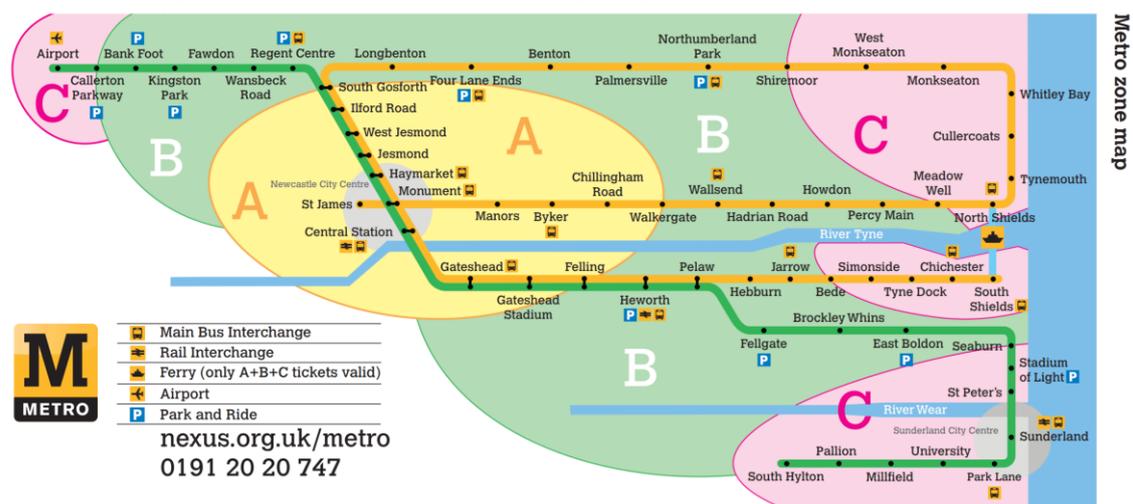
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How to reach the city centre from the Newcastle Airport by Metro:

The journey to Newcastle city centre (*Haymarket, Monument or Central Station*) takes around 25 minutes. There are trains every 12 minutes from approximately 05:44 am (Sundays 06:27 am) to 11:58 pm. More info: www.nexus.org.uk

Tickets can be purchased at ticket machines. Single trip for zones A+B+C costs £3.40



Venue of the social dinner (Pitch & Piano):

108 Quayside, Newcastle upon Tyne NE1 3DX.

Google Maps: <https://goo.gl/maps/meXkRxcCHy72>

Map of the event venue:

Merz court on Google Maps: <https://goo.gl/maps/NYDuyxb3ddo>

Venue of the European Researchers' Night:

Great North Museum, Newcastle upon Tyne NE2 4PT

Google Maps: <https://goo.gl/maps/i7R4QXeuA3w>

Invited Speaker: Professor Robert A. Smith

Department of Mechanical Engineering, University of Bristol, Bristol BS8 1TR

Bio: I have 30 years of research experience in ultrasonics, signal processing, data analysis and instrumentation, the first six years being at the National Physical Laboratory (NPL) where I was involved in establishing a National Measurement System for medical ultrasound field characterisation and contributed to the preparation of international standards. In 1989 I moved to the Non-destructive Evaluation (NDE) Group at the Royal Aerospace Establishment, Farnborough, later becoming the Defence Evaluation and Research Agency (DERA), and then QinetiQ Ltd. Whilst there, I developed the ANDSCAN® portable scanning system and arranged for its commercial exploitation. More recent activities have included the development of TRECSAN® – a transient eddy-current instrument, 3D-VALIDATOR™ for 3D-profiling the ply stacking sequence and ply wrinkling of composites, and PINPOINT® for automated analysis and sentencing of composite C-scans. My current areas of interest focus on composite inspection for aerospace and renewable power, especially the ultrasonic 3D characterisation of the inner quality of composites. Through an EPSRC Fellowship in Manufacturing, I am now seeking to build an academic research programme at the University of Bristol that benefits from my extensive experience in the use of structural composites in a wide range of applications from wind turbines through maritime vessels to aircraft and spacecraft, and of composite manufacturing processes from first-hand experience spanning four continents and several industries.

Topic #1: Advanced ultrasonic NDT of composite materials

Abstract: The route to leaner composite aerostructures requires advanced 3D non-destructive characterisation methods to provide confidence that the as-built structures conform to the design expectations. Ultrasound is the ideal vehicle for exploring the detailed local response of a composite structure to stress and map this across the whole 3D structure. The wavelength, bandwidth and beam width can be optimised for just the right sized volume element to characterise plies and fibre tows, whilst providing data that can be inverted to give 3D fibre direction, ply spacing, fibre volume fraction and, in the future, 3D porosity distribution. This paper will explore the new 3D ultrasonic methods and demonstrate their potential for revolutionising the design of composite aircraft.

Topic #2: NDT for structural integrity and airworthiness of composite aircraft.

Abstract: The link between NDT and structural integrity is completely different for composite materials to metallic materials and this explanation, based on the extant civil airworthiness regulations, will make clear how improved NDT may open up the design space for more optimised and efficient composite structural designs.

Topic #3: The move towards rapid deployment of industry-focused NDE research in the manufacturing industry (RCNDE lecture)

Abstract: The context for his presentation on transitioning of NDE technology is Prof. Smith's 35 years of research experience in the UK civil service, industry and now academia, leading to his election to the post of Director of the UK Research Centre for NDE (RCNDE) with effect from July 2018. He will describe the close relationship between academic researchers and industrial end-users that has developed in RCNDE, as well as the various methods for transitioning technology that have been used. Barriers to the uptake of new technologies have been identified by the British Institute of NDT, of which Prof. Smith was President in 2015 and 2016. These barriers will be discussed in terms of identifying where NDT can provide a benefit rather than a burden by holding 'NDT Requirements' workshops including regulators, insurers, researchers, designers, manufacturers and end-user operators.

A new route will be described for transitioning academic algorithms that have been published in the public domain but face a significant 'chicken and egg' challenge to achieve a multi-supplier offering into the end-users. In this situation, NDE suppliers will not have exclusivity

so the cost of introducing a totally new technology is difficult to justify without considerable technology-pull from end-users. That 'pull' will not be forthcoming if the end users are not confident of a multi-supplier supply chain in the future.

The proposed new route to tackle this problem involves reducing the cost of software development by transitioning software-engineering documents rather than software libraries. This allows supply-chain customization for competitive advantage and software that is owned by each NDE equipment supplier who developed the software. In addition, end-users are engaged early on to define their usage and requirements and a software-test capability is developed using reference samples and data sets so that end-users can test each implementation of the algorithms to check performance against the original published capabilities. The pilot program for this new transitioning route is under way and will be used to illustrate the process.

Invited Speaker: *Professor Anthony J. Peyton*

*School of Electrical and Electronic Engineering, University of Manchester,
Manchester, M13 9PL, UK*

Bio: Anthony Peyton graduated with a B.Sc. in Electrical Engineering and Electronics from UMIST, 1983 and later received his Ph.D. in medical instrumentation in 1986. Then he was as a Principal Engineer at Kratos Analytical Ltd working on mass spectrometers. Appointed as Lecturer in 1989 and Professor of Electromagnetic Tomography Engineering May 2004. Peyton has over 30 years of experience in a diverse range of electromagnetic sensor systems; he has been Principal Investigator of numerous national and industry funded projects and a partner of ten previous EU projects, one as coordinator, co-author on over 130 international journal papers related to electromagnetics and tomography; most recently winner of the IOM's Williams Award in two consecutive years (2014 and 2015) for papers of particular merit to the steel industry.

Topic: Electromagnetic sensing and imaging techniques

Abstract: This presentation will take a new look at electromagnetic inspection based on induction, which offer very well-established family of techniques serving many sectors such as non-destructive testing (NDT), avoiding contamination in the food industry, security at transport hubs such as airports and at public building and detection of buried targets. The presentation will review basic concepts drawing together the similarities of the techniques used across a range of industries. The presentation then considers the potential for electromagnetic induction sensors to exploit spatial and spectral measurements and advanced signal processing and inversion algorithms to determine parameters for particular applications. Finally, the presentation will conclude with examples of successful applications of advanced electromagnetic techniques in fields such as NDT, security, food processing, detection of buried objects and scrap sorting.

Invited Speaker: *Dr. Francesco Ciampa*

Department of Mechanical Engineering Sciences, University of Surrey

Bio: Dr. Francesco Ciampa is a Lecturer in Aerospace Structures at the Department of Mechanical Engineering Sciences of the University of Surrey. Previously, he was a Lecturer at the University of Bath. Dr Ciampa has ten years of multi-disciplinary experience in numerical and experimental testing of materials and structures for the aerospace and energy sectors, in which non-destructive inspection, structural health monitoring, smart composites and energy harvesting have been his major focus areas. Dr Ciampa specialises in ultrasonic and thermographic techniques for both metallic and composite materials and he created new acousto-ultrasonic solutions for detecting and localising acoustic emissions with sparse transducer arrays. These sensing solutions are currently used by leading aerospace companies. Dr Ciampa has published 34 journal papers mainly in highly impact factor journals and he has received funding from various sources as both PI and Co-I including Royal Society, EPSRC and EU.

Topic: Advanced Non-destructive Inspection and Structural Health Monitoring of Aerospace Components

Abstract: Aerospace components, typically made of aluminium and fibre reinforced plastic composites, are susceptible to material defects including impact damage, fatigue cracks and debonds, which are likely to occur during fabrication, testing or in-service. Damage inspection is generally performed with traditional non-destructive evaluation (NDE) methods including ultrasound and infrared thermography and structural health monitoring (SHM) systems. This presentation will describe recent research work on new NDE/SHM inspection methods and “smart” composite structures for the detection and localisation of material damage in aerospace components. Various techniques will be here analysed including nonlinear vibro-thermography, long pulse thermography and both linear and nonlinear ultrasonic methodologies with advanced sensing technology. This presentation will also describe recent energy harvesting systems with thermal electric generators that have been created to feed low-power electronic devices.