

MANCHESTER
1824

The University of Manchester

Northwest Composites Centre / NCCEF

Composites at University of Manchester

Dr. Edward McCarthy, Knowledge Exchange Fellow



Mechanical test machine

Knowledge Exchange at NCCEF

Contents

- Role of Composites Fellow
- Composites at University of Manchester.
- Aerospace Research Institute
- National Composites Certification and Evaluation Centre (NCCEF)
- NCCEF: Mechanical Testing
- NCCEF: ATI Project: Wings of the Future
- NCCEF: Non-destructive Analysis
- Centre for Innovative Manufacturing in Composites (CIMComp)
- Centre for Doctoral Training in Demanding Environments

Knowledge Exchange at NCCEF

Role of Composite Fellow

- To promote assets and services offered by NCCEF to the composites community.
- To ensure greater deployment of knowledge and technologies developed during EPSRC research projects to the supply chain.



Fibre Braiding



9-axis Fibre Placement

Routes to Knowledge Transfer

1. **Knowledge Transfer Partnerships:** 6 months to year: e.g. graduate placement with NCCEF facility/expertise support
2. **Impact Acceleration:** Shorter projects delivered by experts aimed at deploying new knowledge / technology into business
3. **Demonstrator Projects:** Delivered and managed by KE Fellow: applied focus.



northwest
composites
centre

National Composites Certification and Evaluation Facility



The University of Manchester
Aerospace
Research Institute

NWCC, NCCEF & UMARI

Part of a Regional Network

The **Northwest Composites Centre (NWCC)** is a consortium of the Universities of Manchester, Liverpool, Bolton, Lancaster and Glyndwr.

The **National Composites Certification and Evaluation Facility (NCCEF)** is the commercial arm of the Composites Centre at Manchester, and works with all major primes and Tier 1, 2 suppliers.

The **Aerospace Research Institute (ARI)** is a group of experts from across UoM with a wide range of interests from electrical systems to simulation.

NCCEF People



Dr. Prasad Potluri
Research Director



Prof. Constantinos Soutis
Director of ARI & NCCEF



Prof. Andrew Walker
Commercial Director



Dr. Clara Frias
Research Project
Manager, Structural
Health Monitoring



Dr. Arthur Wilkinson
Director of Teaching,
Polymer Processing



Dr. Matthieu Gresil
Lecturer (NDT), Non-
destructive Testing

ARI: Main Research Themes

- Advanced Electrical Power Systems
- Advanced Materials and Structures
- Fluid Dynamics and Flow Control Technology
- Electromagnetic Systems Engineering
- Environmental Technology & Advanced Propulsion
- High Temperature Materials
- Advanced Manufacture
- Synthetic Environments and Systems Simulation
- Reliability, Availability, Maintenance and Safety
- Systems Engineering
- Sensor Technologies
- Environment
- Enterprise Solutions
- Integrated Mathematics



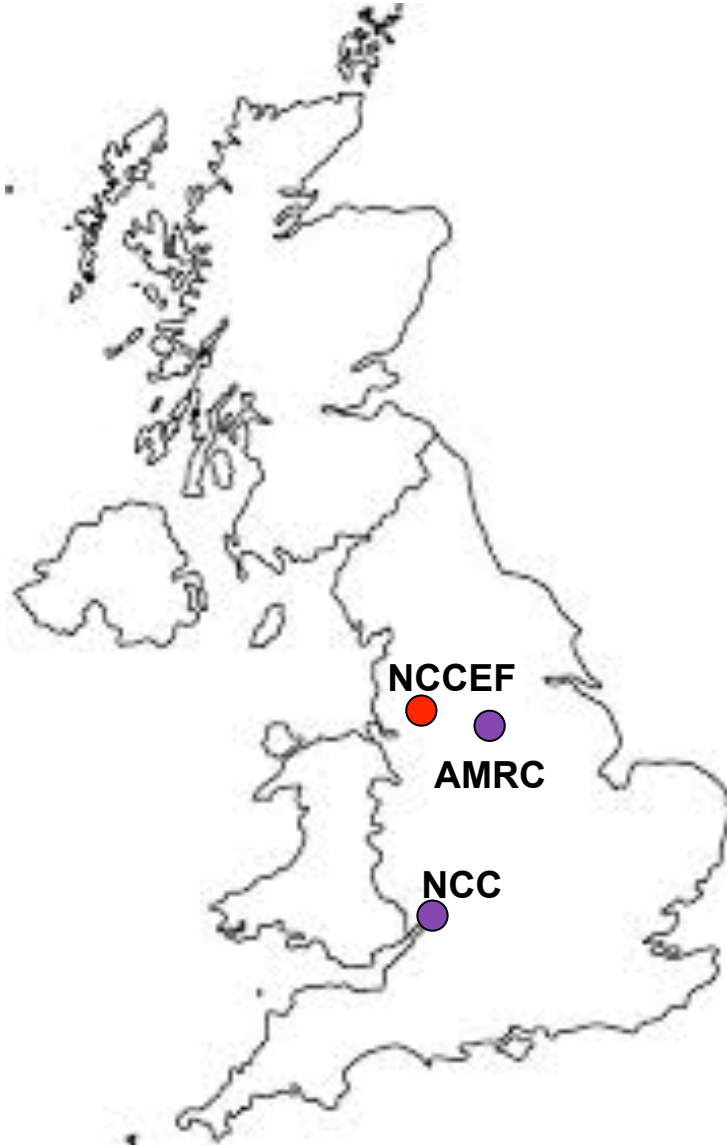
NCCEF in National Context

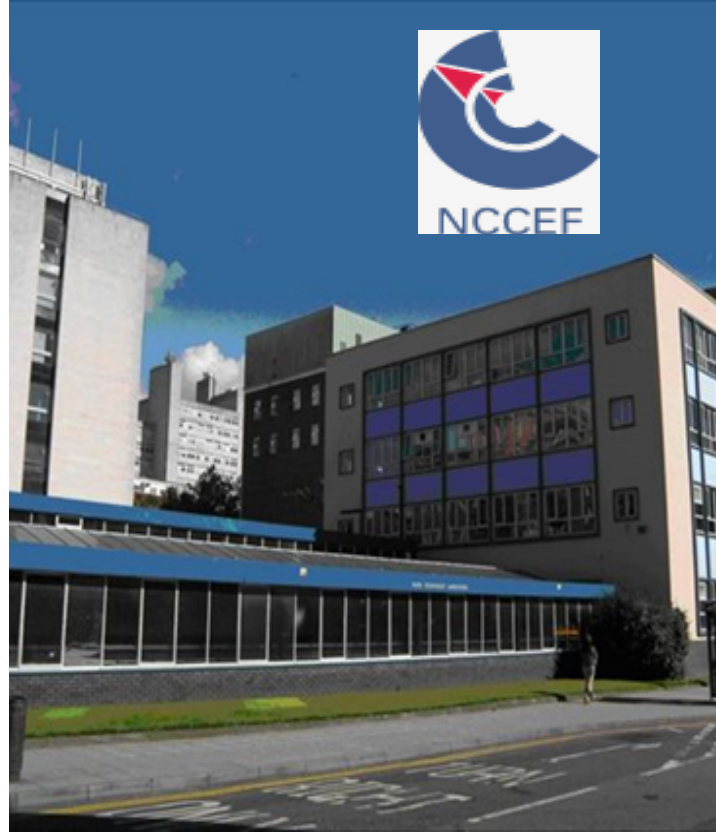
UK Composite Centres

NCCEF is concerned with testing and evaluation of composites, and is UKAS-accredited for this purpose.

The **National Composite Centre (NCC)**, Bristol is one of the seven centres of the High Value Manufacturing Catapult ***dedicated to manufacturing*** issues at all scales.

Other composite centres: **Advanced Manufacturing Research Centre (AMRC)**, Sheffield + many universities & RTOs, ***heavily focussed on manufacturing***. Also NPL.





National Composites Certification and Evaluation Facility

NCCEF Background

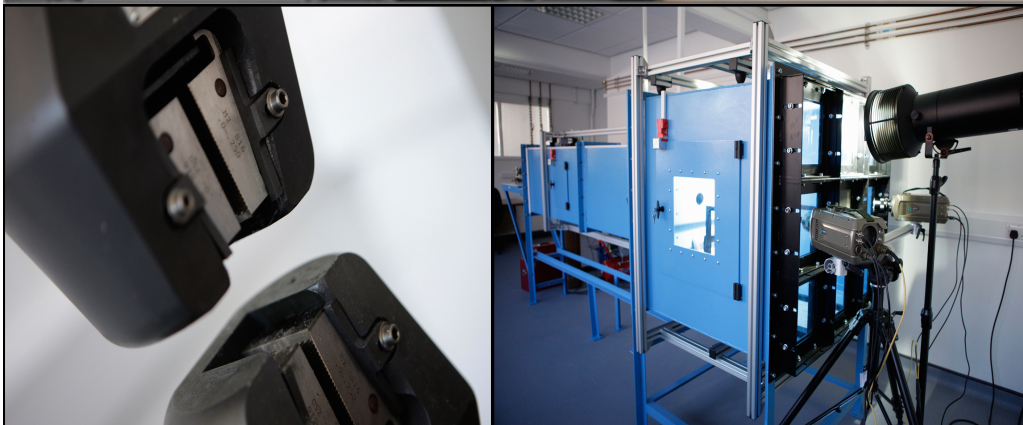
NCCEF Opened January 2010

- UKAS-accredited testing laboratory
- Full range of mechanical and physical testing equipment and non-destructive evaluation facilities

Remit: to work with companies in the supply chain to help them:

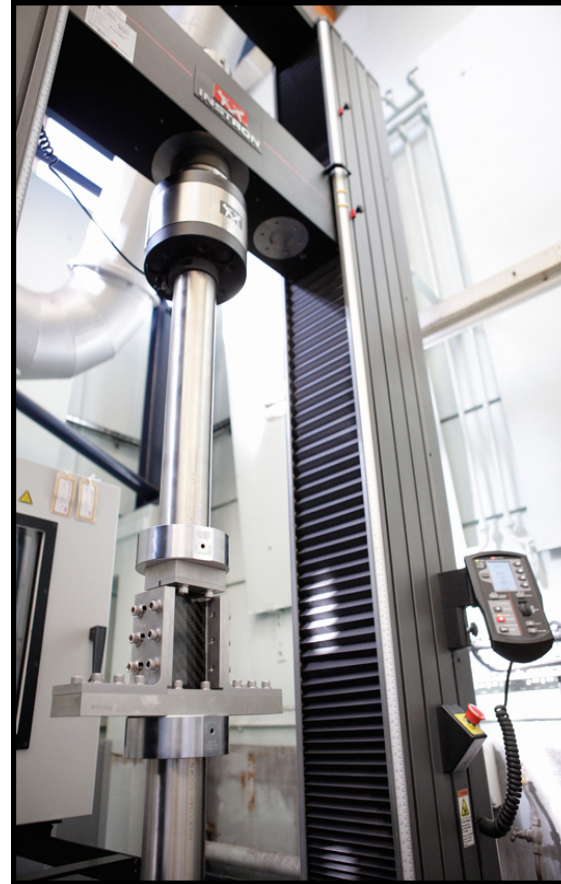
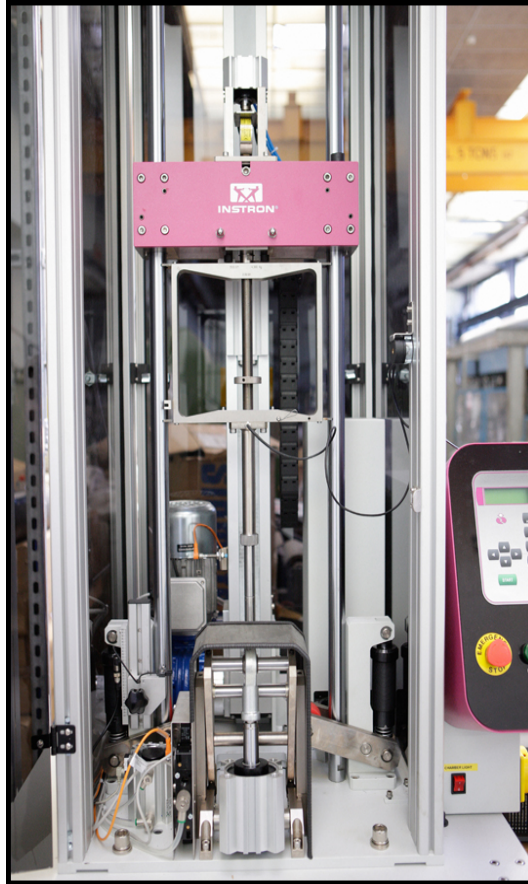
- Assist the transition from metals to composites
- Understand composites behaviour
- Understand and evaluate 3D composite structures
- Understand service performance, including failures
- Assess new composite materials and processes
- Qualify parts for aerospace and other sectors

NCCEF Mechanical Testing

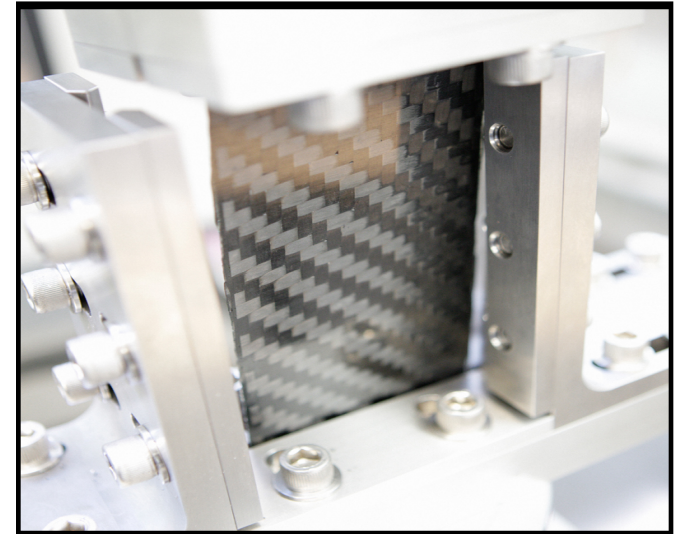


- State-of-the-Art Instron Composites Laboratory houses eight machines.
- Environmental chambers, (-150 °C to 350 °C) high speed camera and contacting/video extensometers
- 3 servo-hydraulic machines up to 250 kN load
- Tension/torsion up to 100 kN/1 kN.m
- Electro-mechanical machine for low cycle fatigue and creep
- Current maximum load: 600 Kn
- Impact Tower
- Ballistic Chamber

NCCEF Mechanical Testing



- Compression-After-Impact for aerospace applications
- Used to assess component exposure to Barely Visible Impact Damage



Identification and localization of sub-surface impact damage a crucial issue for aerospace. The development of non-destructive, ideally non-contact inspection techniques is paramount to increasing confidence.

Substructures: Wings of the Future



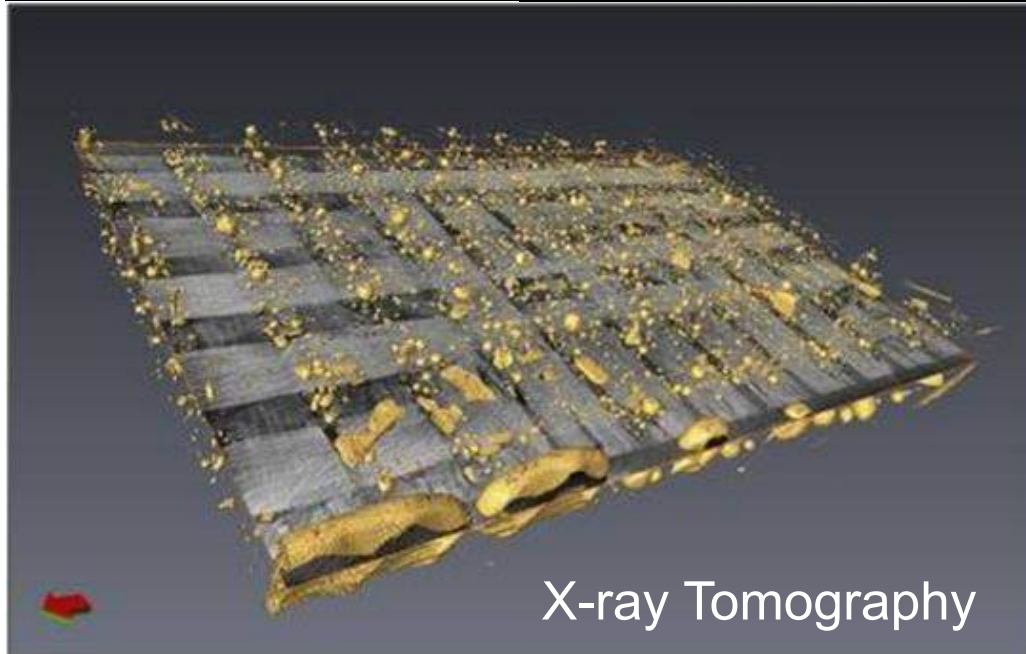
Large Scale Testing

- NCCEF has developed as a major regional and national composite testing resource.
- New £1.2 m sub-structure research project through the Aerospace Technology Institute (ATI) (with Airbus, Spirit Aerosystems, NCC)
- 2.5 MN static frame used to test large composite panels.
- Essential stage of composite development, testing and qualification for final components.
- Will be used to enhance and validate multi-scale models for composite behaviour from coupon to laminate to substructures.
- We are ambitious to assist the drive towards improved composite understanding and design.

NCCEF Non-Destructive Analysis



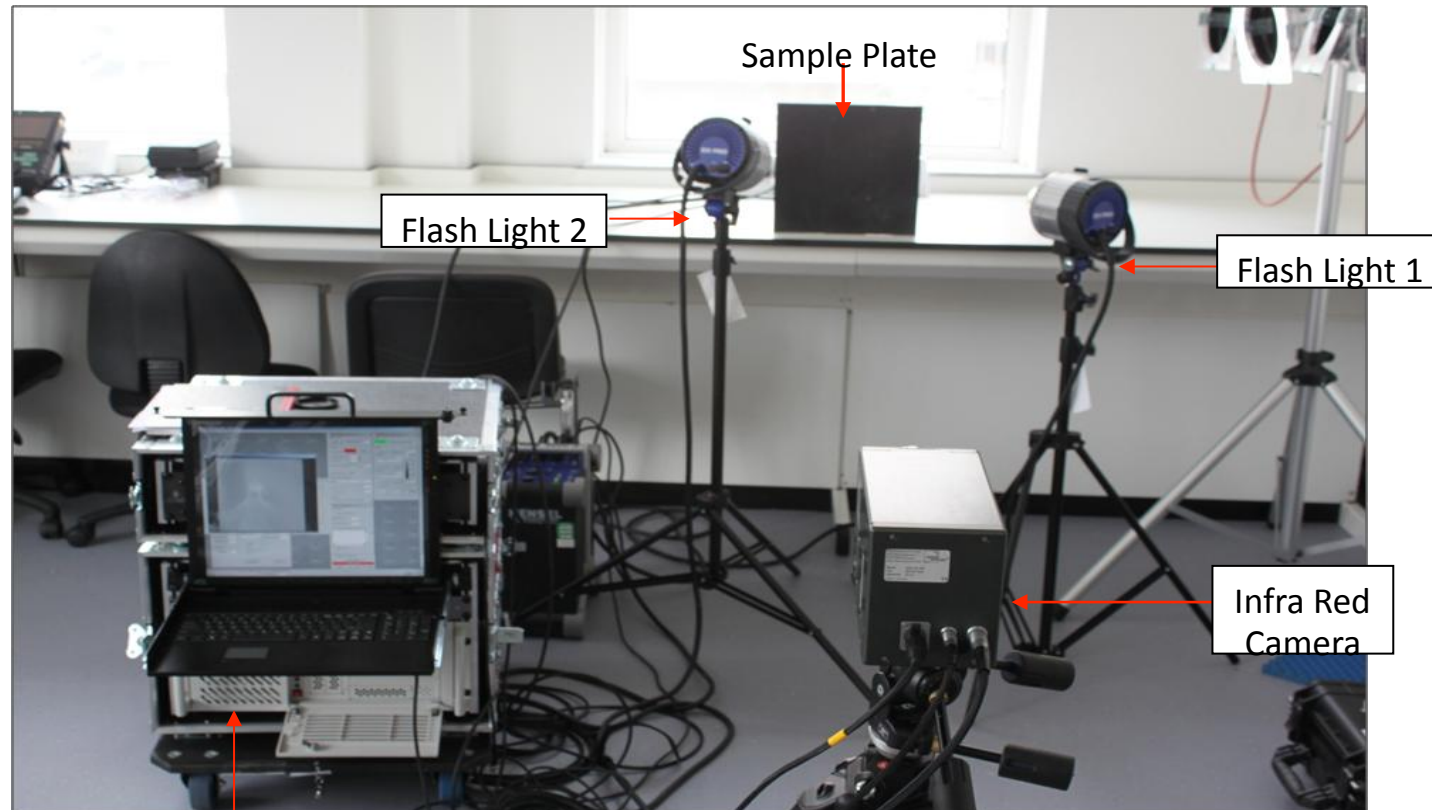
Jet C-Scan



X-ray Tomography

- Jet-coupled C-Scan for assessing manufacturing damage prior to testing
- 64-bit phase array Omniscan
- Ultrasonic bond tester
- Laser Shearography
- Thermography
- £2.5 million X-ray Tomography Facility (Henry Moseley)

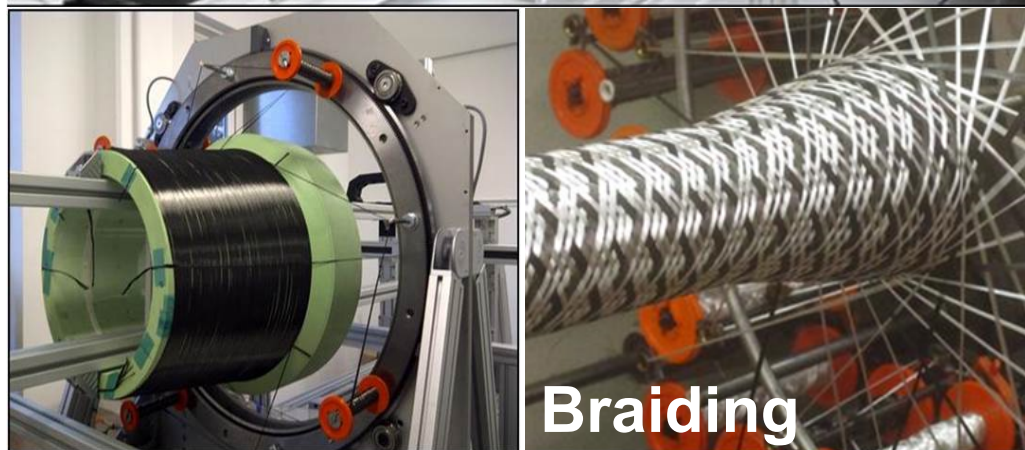
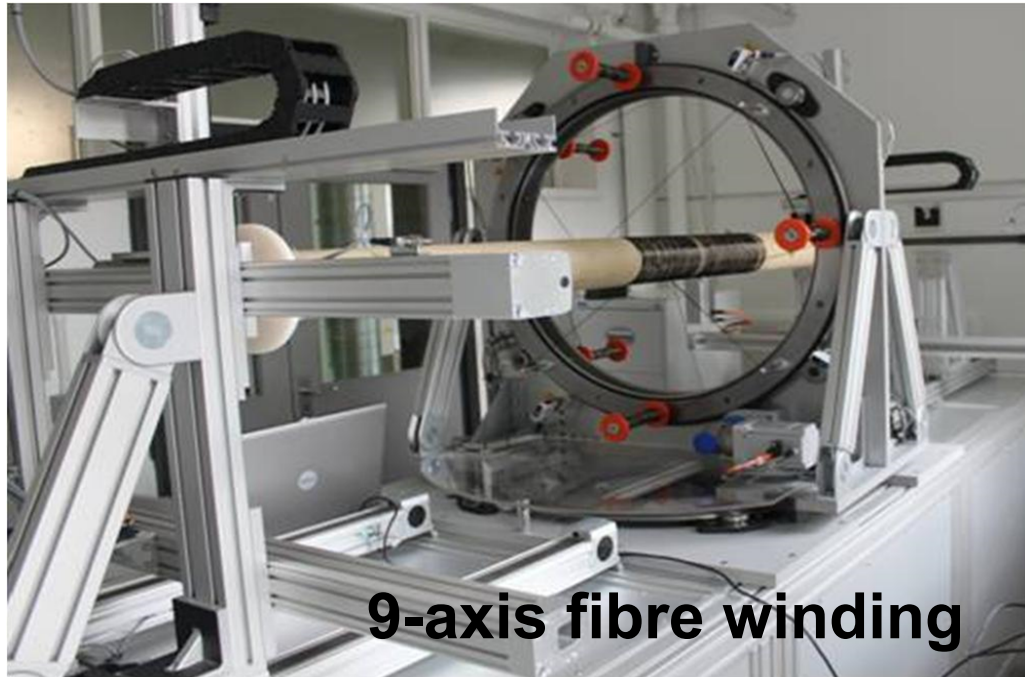
Portable Thermography Equipment to Assess Porosity and Damage



Computer System for
Controlling Camera and Lights
+ Analysing Images

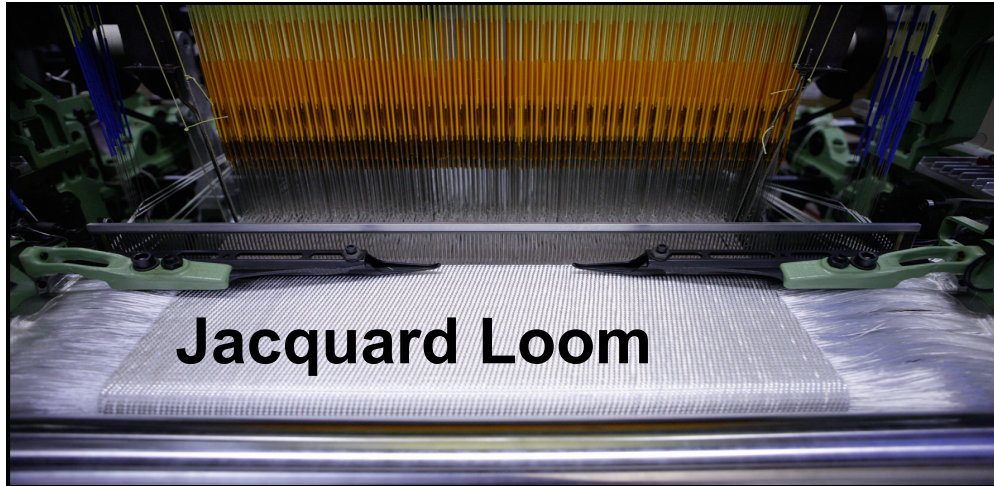
In the case of the current samples – both flash lights
were used simultaneously to obtain even illumination

CIMComp: Textiles Manufacturing

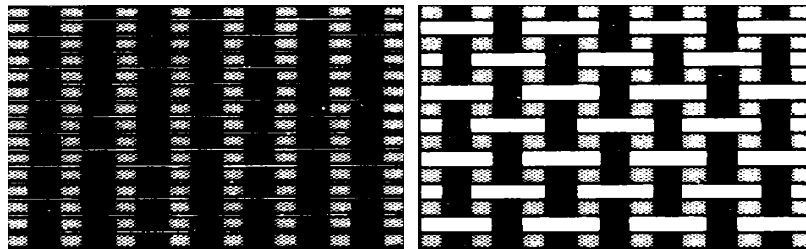


- EPSRC Centre for Innovative Manufacturing in Composites (CIMComp)
- 9-axis fibre winding: static mandrel, rotating bobbin system.
- Can wind non-uniform profiles
- Can customize architectures, use multiple (hybrid) fibres etc.
- CIMComp continues to enhance and improve these technologies to improve design flexibility

CIMComp: Textiles Manufacturing

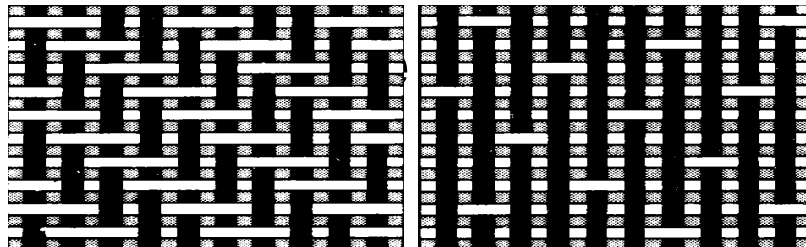


- Jacquard Loom capable of producing advanced three dimensional preforms
- These structures are important for introducing damage resistance and tolerance



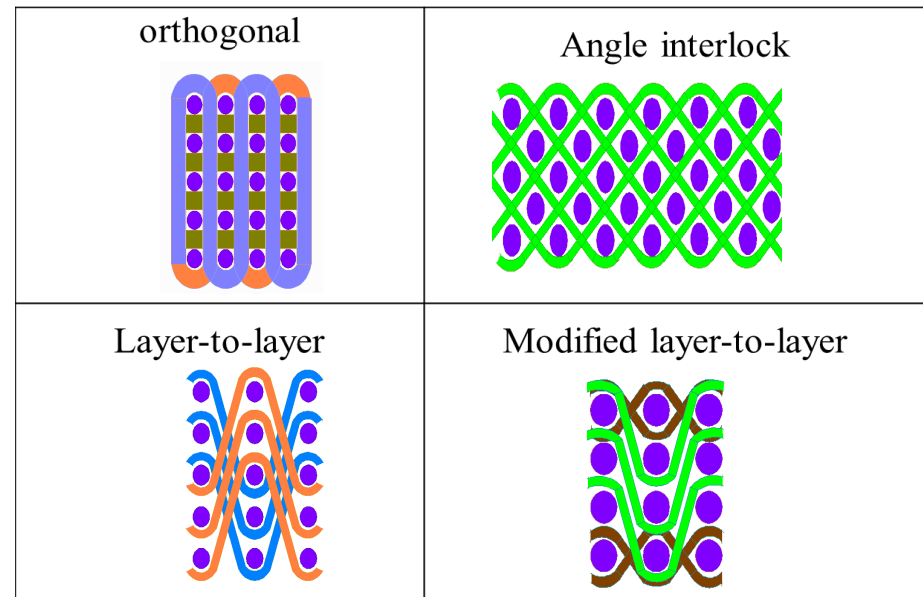
Unidirectional

Plain



Twill 2.2

Satin 8





National Composites Certification and Evaluation Facility

NCCEF/CIMComp Summary

- **NCCEF** performs a range of standard and industrial classic tests.
- 17 tests are UKAS-accredited.
- However, ***'not just testing'***
- Will also develop bespoke testing with you.
- Keen to integrate NDT and modelling into longer term projects.

- **CIMComp** undertakes advanced textile research and development
- A focus on damage tolerance/resistance
- Developing better manufacturing solutions
- ***Knowledge Exchange is designed to deliver this added value.***

Centre for Doctoral Training in Materials for Demanding Environments



BP plc



Rolls-Royce plc



EDF Energy

The University of Manchester

Directors: Prof. Philip Withers FREng FRAes FIMMM
Prof. Bob Ainsworth FRS FREng

Focus of training & research

- » Structure, properties & performance of engineering materials in demanding environments (*incl. alloys, composites, ceramics, coatings*)

Timeframe

- » First cohort of **12** students will start **October 2014**; 4 year course.

(There will be **4** subsequent annual intakes of **20** students per cohort).

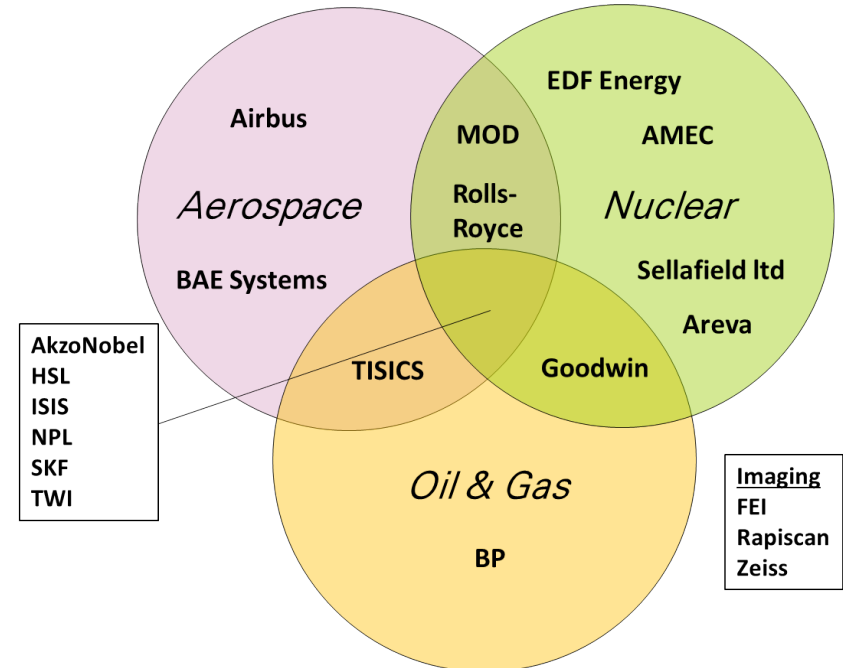
Cross-sector industry support

Industry tailored PhD research

Costs: **£15,000** p.a. for **1** student

This is a 4-year commitment, and will contribute toward an enhanced student stipend, research consumables, and other CDT costs.

This fee leverages EPSRC / UoM funding.



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Thank you

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