University of BRISTOL

One Minute Introductions To Posters From ACCIS Researchers

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accis

ADVANCED COMPOSITES CENTRE FOR INNOVATION & SCIENCE

What to expect in the next 15 minutes…!

- Well anything could happen!
- But in theory…
  - ACCIS PhD students and PDRAs will present their research in 60 seconds
  - Their aim is to 'attract you' to their poster display…!
  - Internally, we have tried to select a diverse range of research projects to show you the breadth and depth of ACCIS capabilities.
  - All participants have practiced at least ONCE…!
- Let me give you an example…

Multifunctional Research Group

Advanced Composites Centre for Innovation and Science

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Department of Aerospace Engineering
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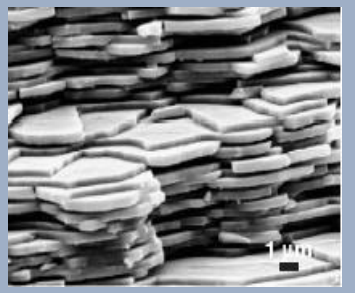
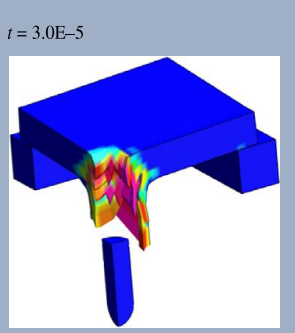
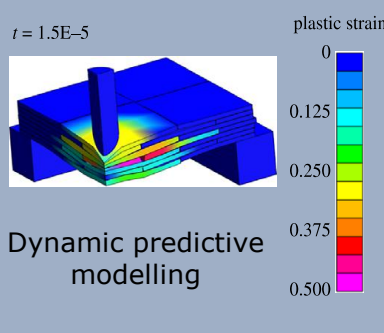
- Investigating **bio-inspired** multifunctional composite materials covering:

- **Hierarchical organization** of structure
- **Controlled orientation** of structural reinforcement
- **Functionally graded properties**
- **Durable interfaces** between hard and soft components
- **Graceful Degradation** through unique damage absorption
- **Remodelling/ self-healing** through inherent vascularity

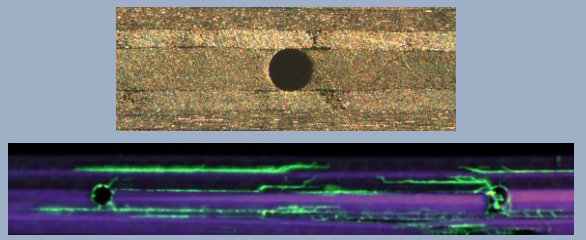




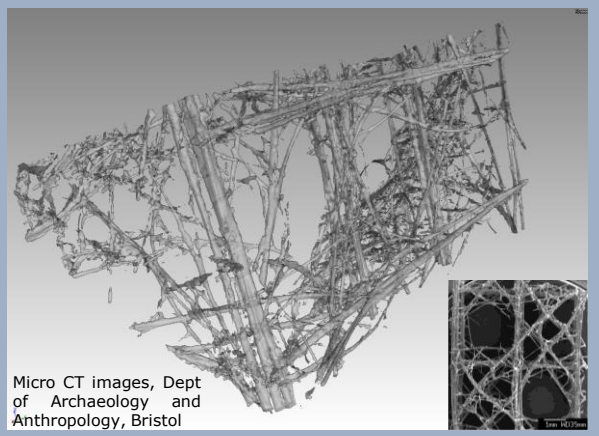


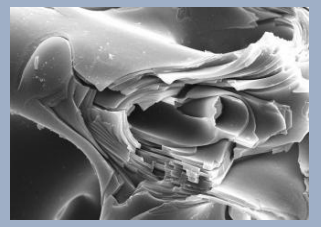
Dynamic predictive modelling

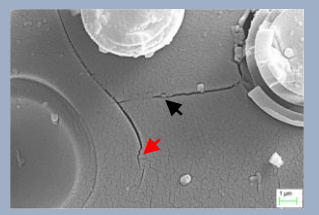
Biologically Inspired Next Generation Outer Body Armour



Engineering Synthesis Of Biological Healing







Hierarchical Organisation And Graceful Degradation

Running Order

- Marco Capuzzi
- Dr Christian Knipprath
- Xavier Lachenal
- Dr Gregory McCombe
- Christopher Norris
- Matthew O'Donnell
- Dr Alberto Pirrera
- Michael Russ
- Alexander Shaw
- John Williams
- Dominic Bloom

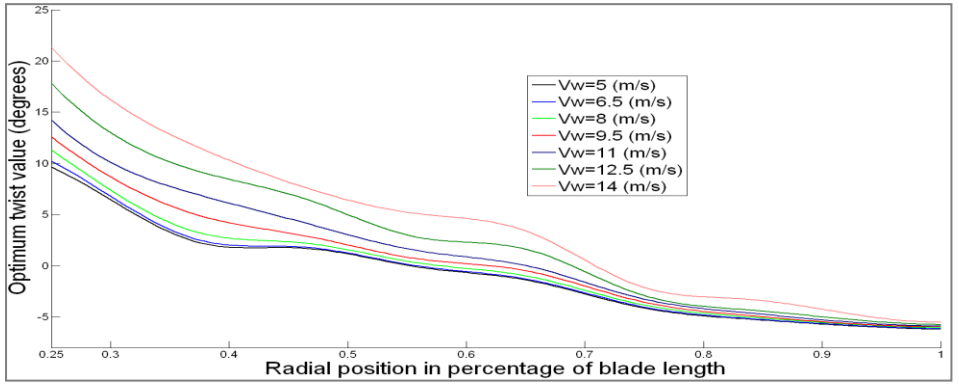
Marco Capuzzi

AEROELASTIC TAILORING OF WIND TURBINE BLADES USING TOW STEERED LAMINATES

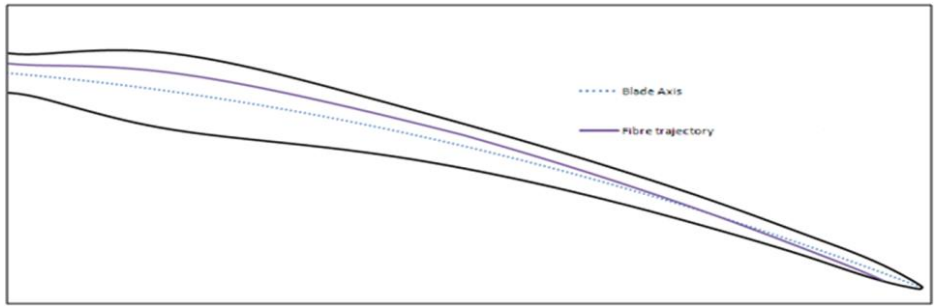
The main purpose of the project is the design of a passive adaptive blade, which deforms towards the optimum aerodynamic shape when loaded during operating conditions. The passive adaptive capability is sought by using variable stiffness materials as tow steered laminates.

1) Aerodynamic Analysis

Evaluate the optimum twist distribution which maximizes the power yielded.



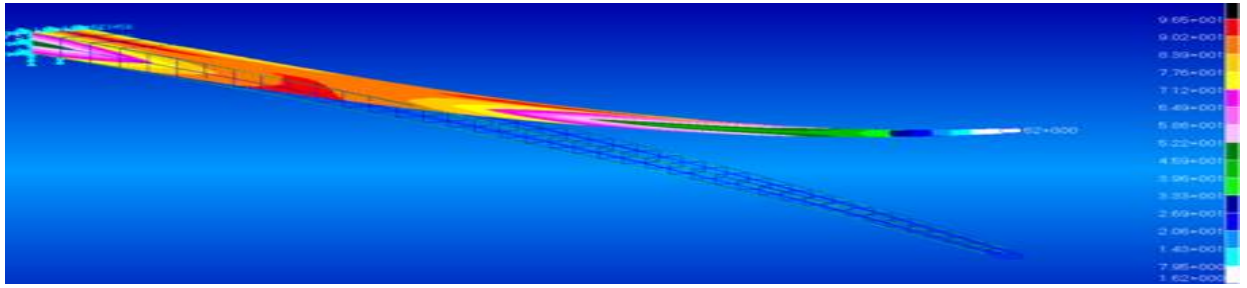
2) Structural concept



By mixing the geometrical and material bend-twist coupling capabilities we can change and invert the induced twist rate along the blade's radial direction.

3) Refined FE analysis of the adaptive spar solution

We *successfully checked* whether the adaptive behaviour compromises *strength and stability* (buckling).



Next Steps

-Tailoring of the stiffness on the whole blade section.

-Moving towards more advanced design stages.

Marco Capuzzi *and Paul Weaver*

Supported by Vestas

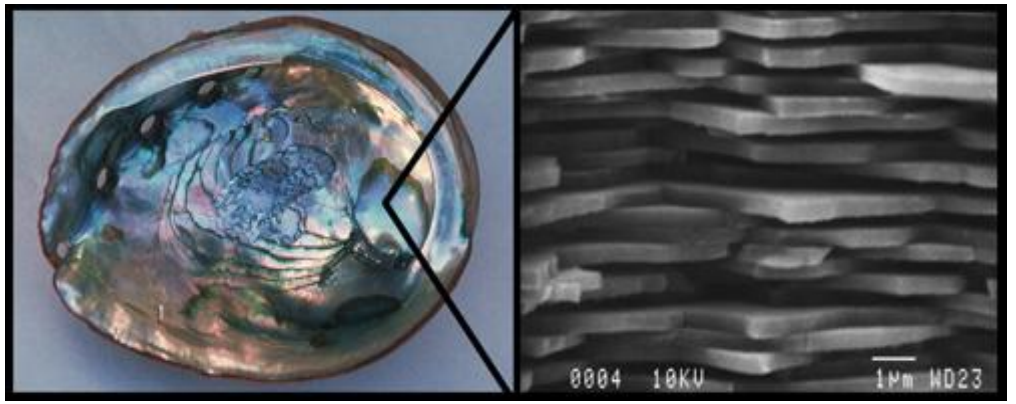
Dr Christian Knipprath

BINGO

Biologically Inspired Next Generation Outer Body Armour

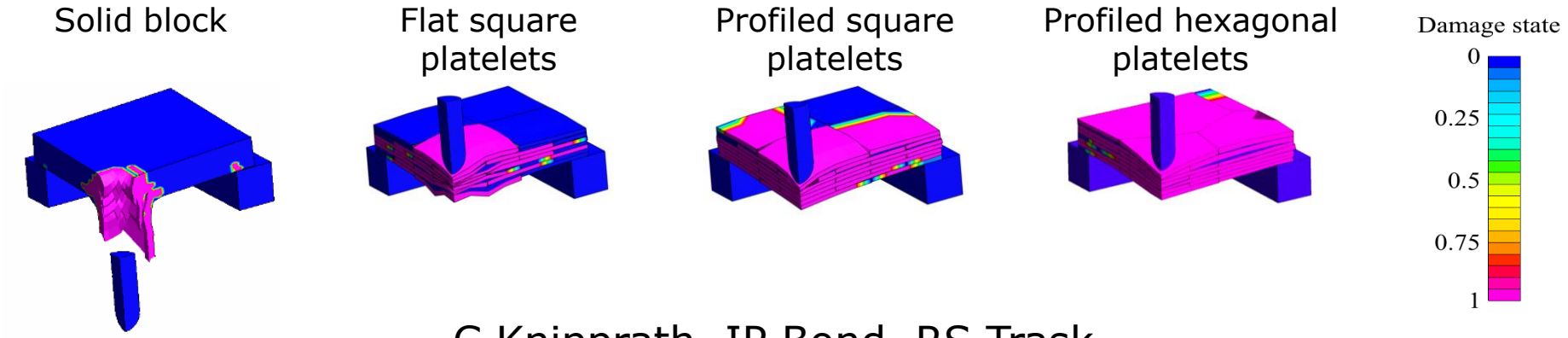
Christian Knipprath
c.knipprath@bristol.ac.uk

- Concept
  - Discontinuous composition using platelet arrangement



[F. Barthelat, Bioinspiration & Biomimetics, 2010]

- Research progress



C Knipprath, IP Bond, RS Trask

Xavier Lachenal

Concept for a Bistable Composite Twisting Structure

Xavier Lachenal - Supervised by Paul Weaver

Aim:

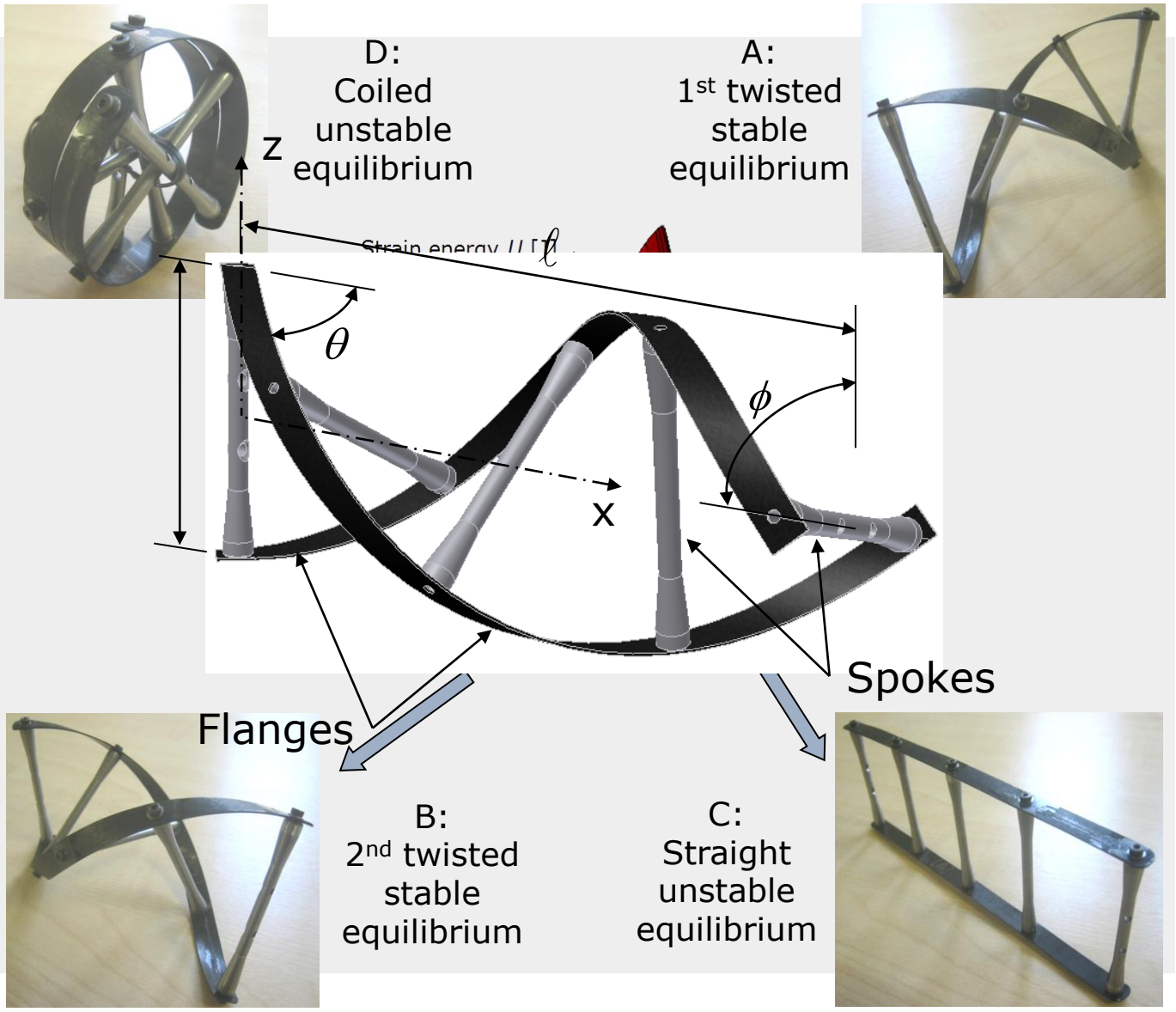
Model and design a bistable structure capable of large deformations

How:

Inextensional deformations and fibre orientation tailoring.

Result:

- Simple analytical model.
- Position of the stable equilibria tailored to any angle.
- Zero stiffness along the axis of twist also possible.

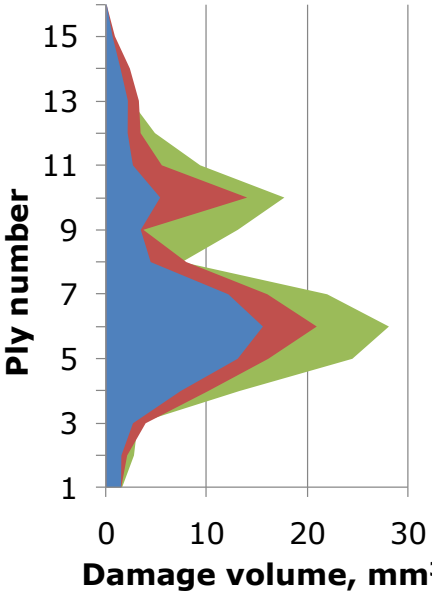


Dr Gregory McCombe

Damage Visualisation in Self-Healing Composites

Greg McCombe – greg.mccombe@bristol.ac.uk

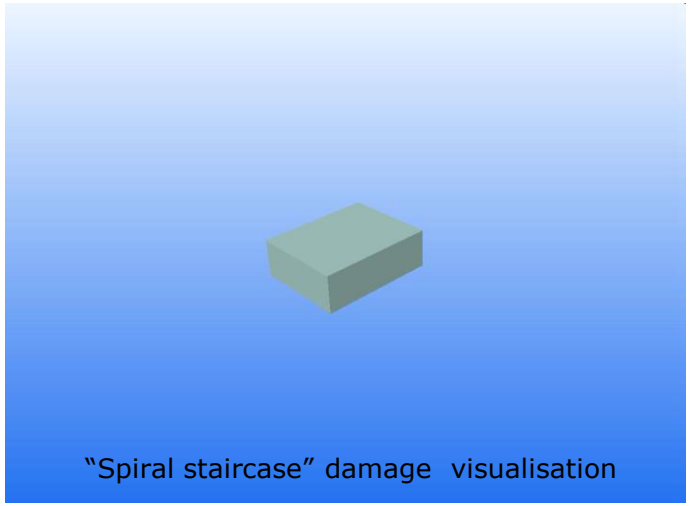
- **X-ray µCT for low velocity impact damage characterisation in CFRP**
  - Henry Moseley facility at the University of Manchester



Through thickness damage map

- **Quantify / map / visualise damage volume & assess healing system interaction**

- **CRASHCOMPS**
  - CRack Arrest & Self Healing in COMPosite Structures
  - ICL & UoB partnership funded by EPSRC & DTSL



"Spiral staircase" damage visualisation

McCombe, Rouse, Trask, Withers & Bond

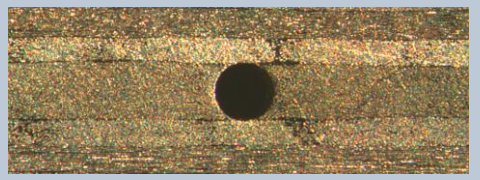
Christopher Norris

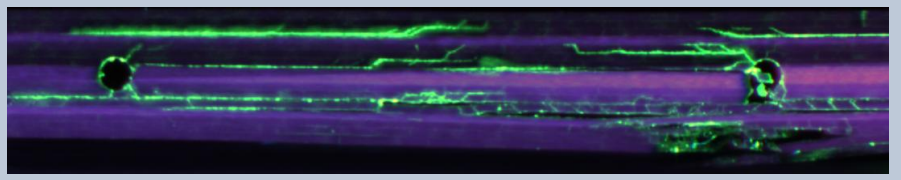
Self-Healing via Vascular Networks in FRP's

The Challenge – Composites susceptibility to out-of-plane impact threats -> BVID –> significant reductions in mechanical performance.

Proposed Solution – To incorporate microvascular networks within a FRP laminate structure that can deliver healing agent from a reservoir to regions of internal damage.

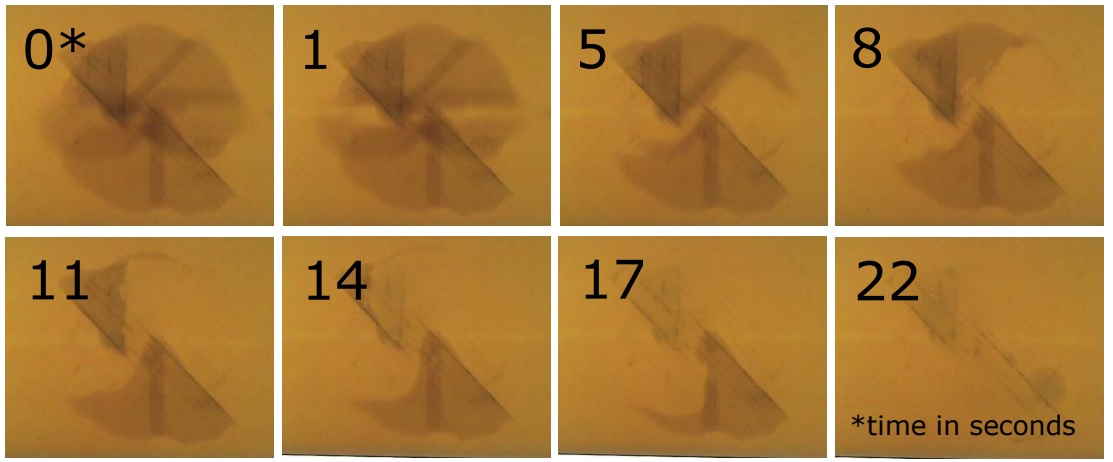
How? – Novel fabrication route developed to minimise disruption to host's fibre architecture and ensure damage-vascule connectivity:





Results:

- Near 100% healing efficiencies demonstrated with CAI test protocol.
- Healing functionality coupled with damage detection technique for autonomous delivery.



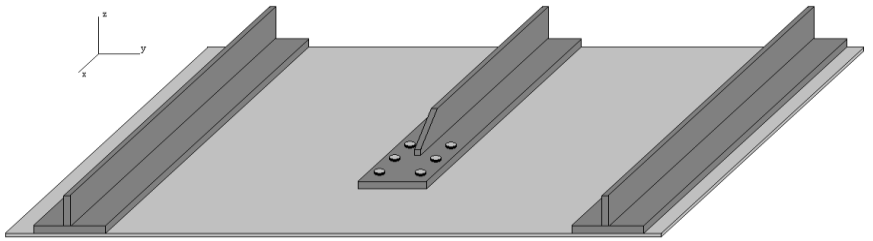
Chris Norris, Ian Bond, Richard Trask.
Chris.Norris@Bristol.ac.uk

Matthew O'Donnell

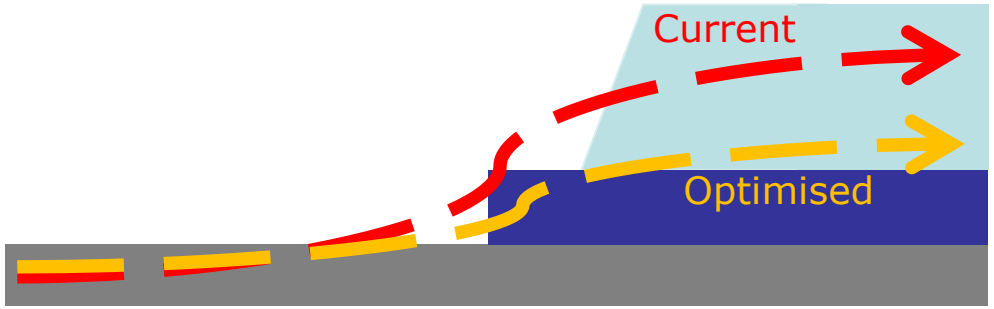
Optimisation of Stringer Terminations

Matthew O'Donnell - aempod@bris.ac.uk

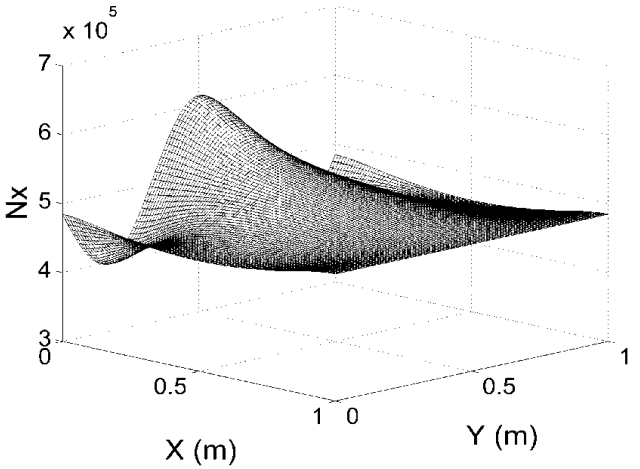
AIM: Reducing Debonding Through Anisotropy



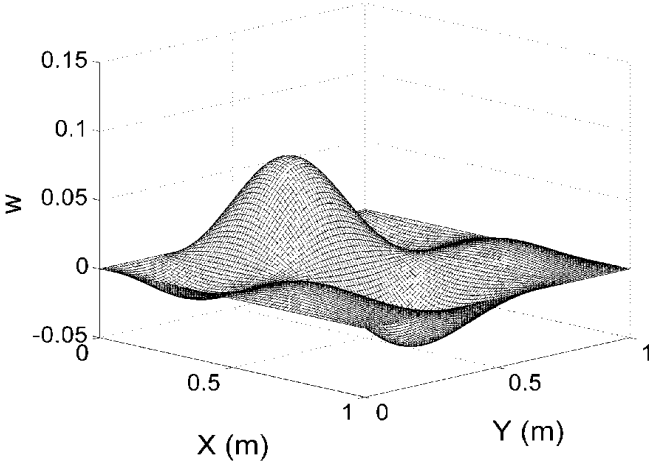
Stiffened Panel



Eccentric Load Path



Stress Distribution



Deflected Shape

***O'Donnell**, Weaver & Cosentino*

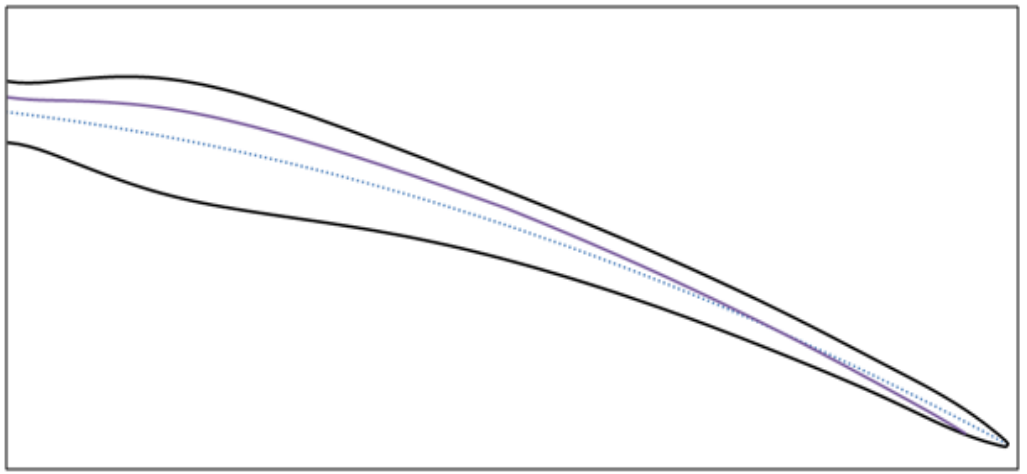
AIRBUS

EPSRC Engineering and Physical Sciences Research Council

Dr Alberto Pirrera

Wind Turbine Blade Structures

- Larger blades can deliver cheaper energy.
- But weight grows faster than energy output!
- We seek novel design methods and structural concepts to beat this trend.
- Weight savings can be realised by means of structural optimisation and aeroelastic tailoring.



Vestas

In the team: N. Buckney, M. Capuzzi, **A. Pirrera**, P.M. Weaver.
Email: alberto.pirrera@bristol.ac.uk

Michael Russ

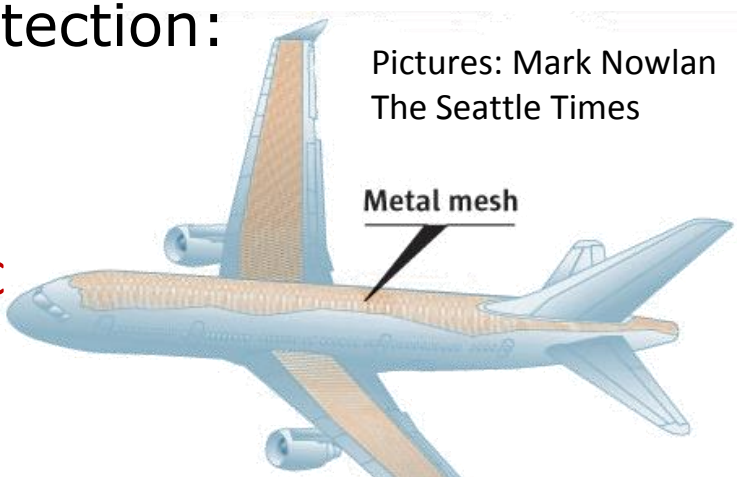
Nanocomposite Approach to Lightning Strike Protection

Mike Russ, Hua-Xin Peng, Sameer Rahatekar & Benjamin Farmer

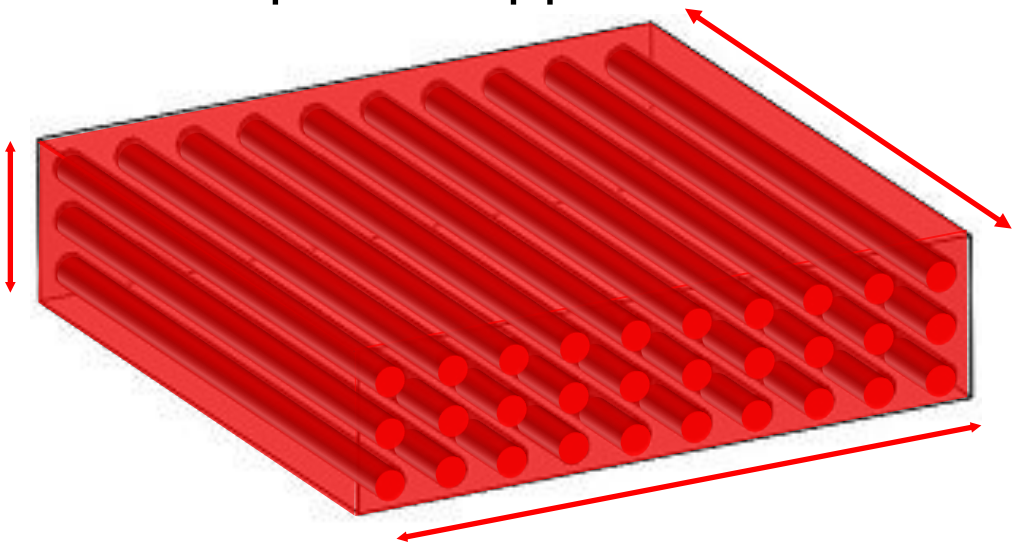
Lightning Strike:

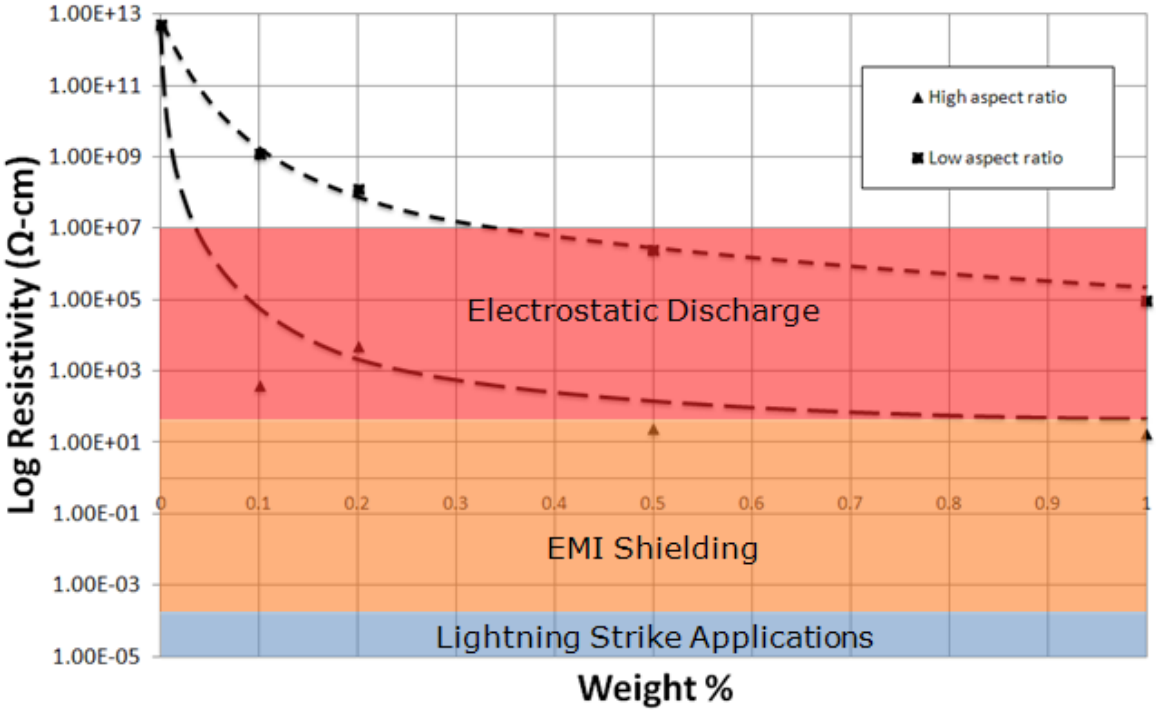
- Impact force: <16kN
- Temperature flux: <28,000° C
- Electrical discharge: <200 kA

Current Protection:



Nanocomposite Approach:



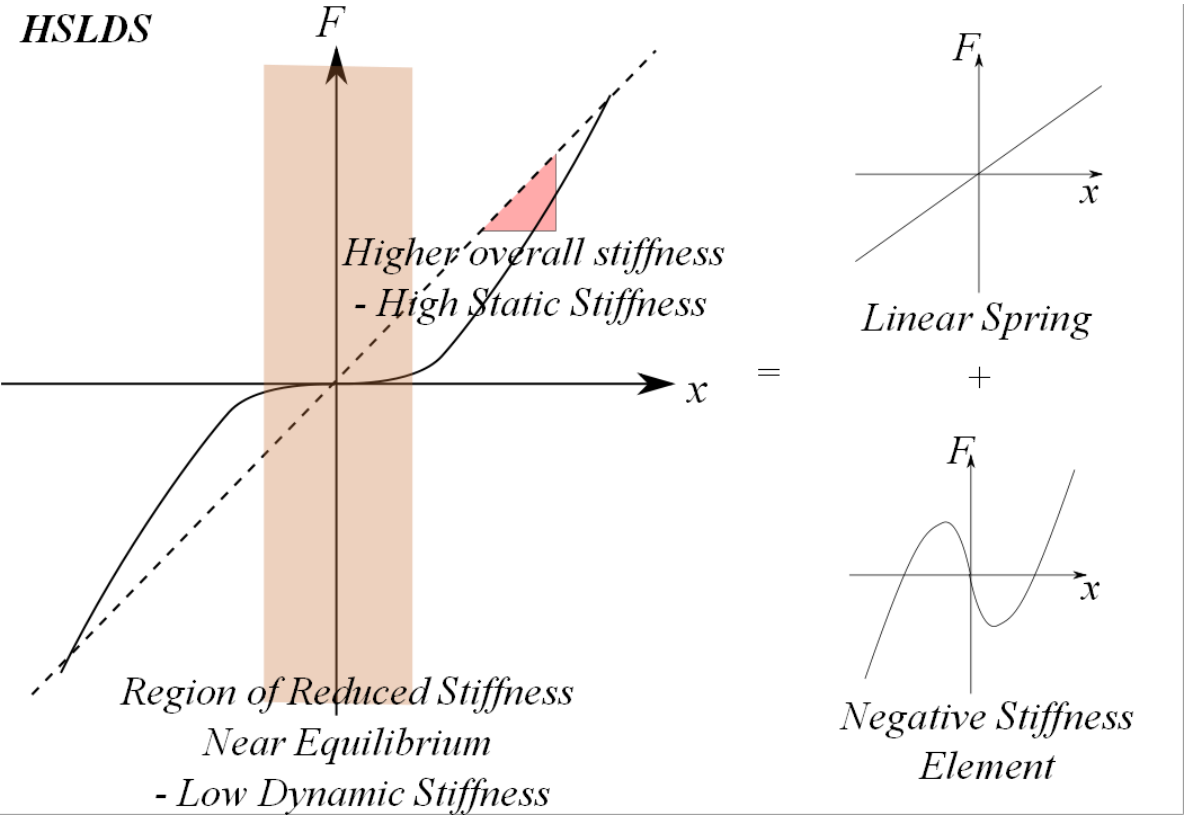


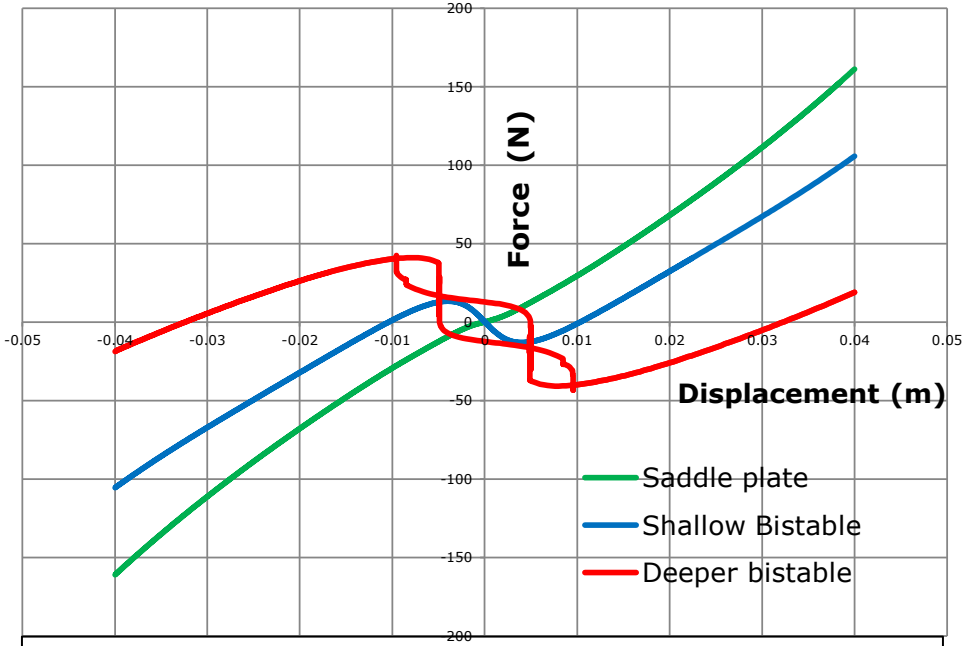
Alexander Shaw

A vibration isolator incorporating a composite bistable plate

A. Shaw, D.J. Wagg, A. Carrella, P.M. Weaver

- Composites tailored to integrate vibration isolation
- High Static, Low Dynamic Stiffness
- New application for residual strain and bistability





Force/displacement curves of asymmetric cross ply laminates

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Alexander Shaw
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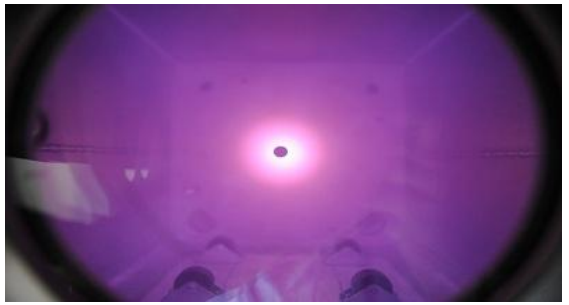
ADVANCED COMPOSITES CENTRE FOR INNOVATION & SCIENCE

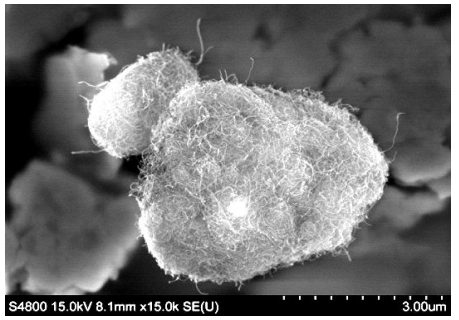
John Williams

Plasma Treated Carbon Nano Tube Composites

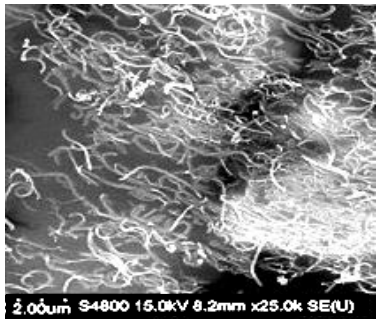
Aim: To use plasma treated carbon nano tubes to improve the physical properties of composites.



Plasma Treatment
Picture by Haydale

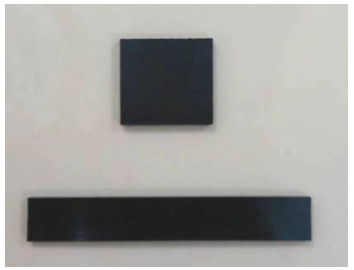


Entangled CNTs
Picture by Haydale

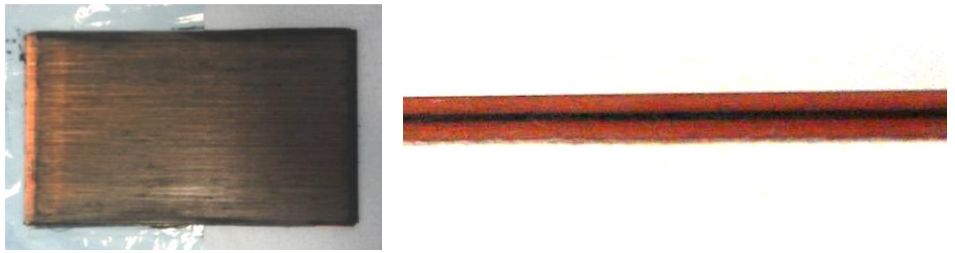


Dispersed CNTs
Picture by Haydale

Processing CNTs into composites



Epoxy Nano Composite



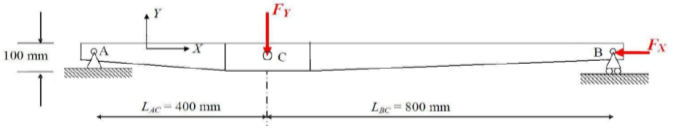
Draw down coated CNT Laminate

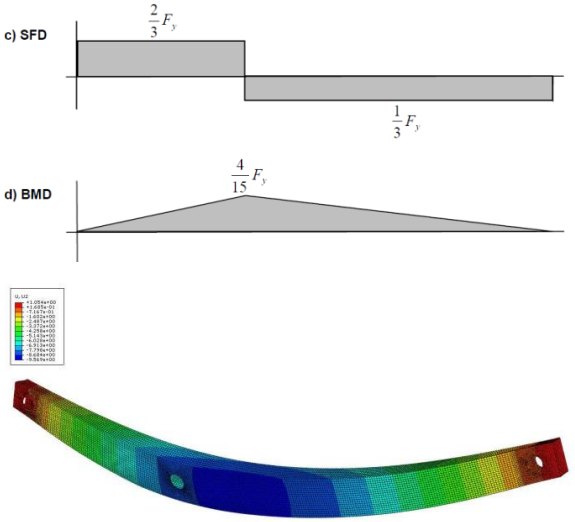
John Williams: aejdw@bristol.ac.uk
Sameer Rahatekar

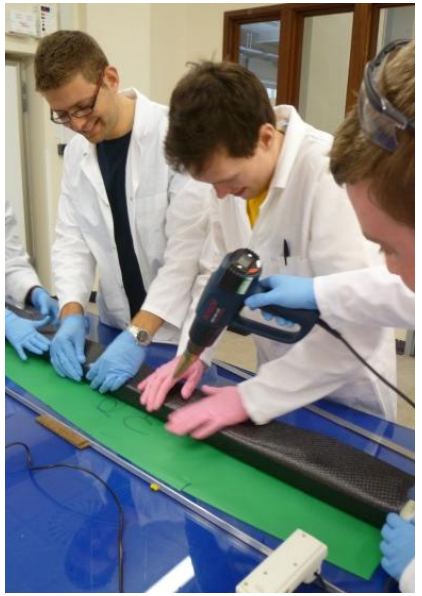
Supported by :

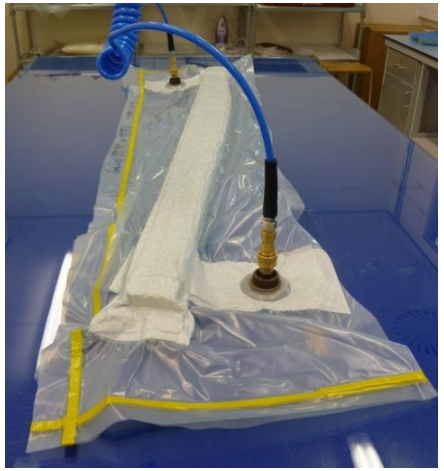
Dominic Bloom

DTC 10 Design, Build & Test









This now concludes the

‘One Minute Introductions’

All research posters can be found in CDO.

We all look forward to meeting you there.