Quickfire Presentations
2-minute-2-slide
Second and third year CDT students

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Running Order

**Structures**
- A one-dimensional snap-through model of the aeroelastic tymbal sound production in Yponomeutidae moths - Hernaldo Mendoza Nava

**Materials**
- Thermally reversible epoxies: self-healing, reshaping and recycling. - Callum Branfoot
- Active thermal management via embedded vascular networks - Jim Cole
- High voltage switching of dielectric elastomer actuators using thin film amorphous Silicon - Calum Gillespie
- Machine-Driven Experimentation For Solving Challenging Consolidation Problems - Antoly Koptelov
- Understanding of Leading-Edge Protection Performance Using Nano-Silicates for Modification - Imad Ouachan
- Nanodiamond composites: comparing manufacturing methods on material properties - Dominic Palubiski
1D sound production model of the Ermine Moth

Hernaldo Mendoza Nava
Rainer Groh, Marc Holderied (School of Biological Sciences), Alberto Pirrera

CDT Conference 2019
16th April, 2019

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Buckling as a defense mechanism

Ermine moths produce bursts of clicks to defend against bats. The sound originates at a clear patch in its wings (aeroelastic tymbal). [1]


1-D sound production model of the Ermine Moth
Hernaldo Mendoza Nava
Tymbal sound production

1. **Static Riks Analysis** – Determine structural instabilities

2. **Modal & SSD** – Rayleigh damping parameters computation

**Explicit Dynamics** – Structural response due to cyclic loading

3. **FFT analysis & Baffled-Piston model** – Calculates the sound pressure level and directionality

**Spectrogram** – Representation of the on axis emitted sound

Future work

FE analysis of a 2D shell model

- A 1D model allowed to reproduce a single click
- Low frequency spectra suggests a pre-stressed structure

1-D sound production model of the Ermine Moth

Hernaldo Mendoza Nava

16th April, 2019
CANs: from dynamic bonds to functional composites

Callum Branfoot, Hartmut Fischer, Tim Coope, Duncan Wass, Paul Pringle and Ian Bond

CDT conference 2019
16/04/19

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Covalent adaptable networks, CANs

Motivation
Poor recyclability, repairability and toughness of conventional FRPs

CANs
Reversibly crosslinked polymers based on dynamic chemistry

Thermoset >> Thermoplastic >> Thermoset

Callum Branfoot / CANs
callum.branfoot@bristol.ac.uk / 16/04/19
Epoxy CANs for composites

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Active Thermal Management via Embedded Vascular Networks

Jim Cole, Ian Bond, Andrew Lawrie

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Problem

- Polymer matrix limits operating temperature due to glass transition temperature, $T_g$
- Significant performance reduction, up to 50% at $T_g$
- Thermo-oxidative ageing over long term
- $T_g$ is typically 100°C to 150°C for aerospace epoxies
- Emerging applications expose composites to higher temperatures:
  - Turbo-machinery
  - Battery containment
  - Hypersonic aircraft

Solution

- Circulate fluid through small passages (vascules) inside the laminate
- Maintain matrix below $T_g$ to retain performance, extend service life
- 4-vascule arrays embedded in QI CFRP samples using PTFE-coated wire
- Custom thermal chamber and test fixture required due to high temperatures
- Tested in four-point flexure up to 170°C ($T_g = 200^\circ$C)
- Initial results indicate a flexural strength reduction of -25% without cooling, and -6% with cooling flow
Acknowledgements

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High-voltage Photonic Switching with Amorphous Silicon Thin-film Composites

Calum Gillespie, Andrew Conn, Johnathan Rossiter, Fabrizio Scarpa, Asier Marzo.

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High-voltage Photonic Switching with Amorphous Silicon Thin-Films Composites.

1. Inspiration

Known optical input
- Optically functional DEA device.
  - Actuation

Unknown optical input
- Optically functional DEA device.
  - Actuation

Wireless Optical Control
- Desired displacement output

Environmental awareness
- Measurable displacement output

2. Current work

- SPIE EAPAD XXI: Paper number - 10966-55

Calum Gillespie
Andrew Conn, Johnathan Rossiter, Fabrizio Scarpa, Asier Marzo.

16.4.19
High-voltage Photonic Switching with Amorphous Silicon Thin-Films Composites.

3. Future applications – Alternative actuation:
   • Electro-active Ribbon Actuators


Amorphous Silicon Poly-imide Composite
Machine-driven experimentation for solving challenging consolidation problems


Supported by the EPSRC Platform Grant, Science and SIMulation of new manufacturing PROcesses for Composite Structures (SIMPROCS)

EPSRC ACCIS CDT Conference 2019
Consolidation and Characterisation testing strategies

Examples of different flow modes in the specimen. [1] Belnoue et al.

No universal testing procedure for compaction of composite precursors

Low viscosity UD prepeggs


Toughened prepeggs

Numerical solution of the first order ODE for the given load history:

Consolidation sensor is capable of recognizing the flow/deformation modes by its characteristic signatures.
Measurement and Understanding of Viscoelastic Wind Blade Erosion Coatings

Imad Ouachan, Kirsten Dyer (OREC), Ian Hamerton and Carwyn Ward.

8th Annual CDT Conference
Tuesday 16th April 2019

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Leading Edge Erosion

- Rain impact velocities of **>100 m/s**
- Emergency repair of several modern wind farms *e.g.* London Array (140 out of 175 turbines)
- Costs the European offshore wind industry between **€56m- €75m** annually [4]
  - Reduced lifetime
  - Decrease in aerodynamic performance (1.5 - 2.5%)
  - Reduction in annual energy production from (3 - 5 %)
  - Inspection and repair programmes
  - Tip speeds limited to ~100 m/s

Imad Ouachan - Measurement and Understanding of Viscoelastic Wind Blade Erosion Coatings

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Results

Nanosilicate Modification

1) Dynamic Thermal Analysis

2) Accelerated Rain Erosion Testing

Unmodified

Nano Modified

Imad Ouachan - Measurement and Understanding of Viscoelastic Wind Blade Erosion Coatings

ACCIS CDT Conference 16/04/2019
Nanodiamond composites; comparing detonation and high-pressure/high-temperature nanodiamonds within epoxy matrices

D. R. Palubiski, N. Fox, F. Scarpa

ACCIS CDT Conference 2019

Wednesday, 17 April 2019

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Nanodiamonds in Resin

Detonation Nanodiamond

High-Pressure/High-Temperature Nanodiamond

D. R. Palubiski
17 April 2019
Nanodiamond in Resin

Experimental Testing of Samples

D. R. Palubiski
17 April 2019

TEM Images of HPHT in Resin