University of BRISTOL

ACCIS Conference 2013

Dr. Mehdi Yasaee, PI: Prof. Stephen Hallett

Through thickness reinforcement of composite laminates

Dr. Gergely Czel, PI: Prof. Michael Wisnom

Novel architectures for ductility in high performance composites

Dr. Eric (Byung Chul) Kim

A novel tow steering technology - CTS (Continuous Tow Shearing)

Dr. Meisam Jalalvand, PI: Prof. Michael Wisnom

Damage mode map and parametric study of UD hybrid composites

Dr. Zhangming Wu, PI: Prof. Paul Weaver

Modelling of Variable Angle Tow Composite Structures

Dr. HaNa Yu, PI: Dr. Kevin Potter

A Novel Manufacturing Method for Aligned Discontinuous Fibre Composites

Dr. Gangadharan Raju, PI: Prof. Paul Weaver

Design and optimization of variable angle tow composite plates

Dr. Julie Etches

Feasibility of Pad Printing For Use in Advanced Composite Manufacturing

www.bris.ac.uk/composites

17th September 2013

accis

ADVANCED COMPOSITES CENTRE FOR INNOVATION & SCIENCE

University of BRISTOL

Rolls-Royce

Through thickness reinforcement of composite laminates

Dr. Mehdi Yasaee

PI: Prof. Stephen Hallett

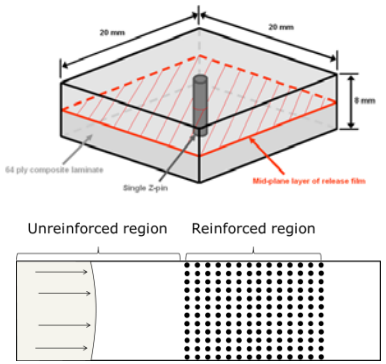
www.bris.ac.uk/composites

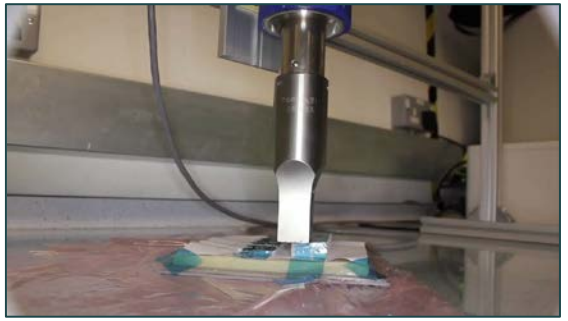
ADVANCED COMPOSITES CENTRE FOR INNOVATION & SCIENCE

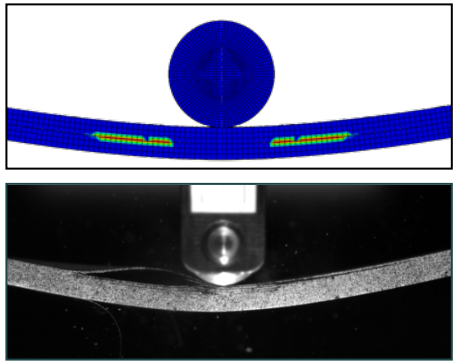
Through thickness reinforcement of composite laminates

Mehdi Yasaee - m.yasaee@bristol.ac.uk

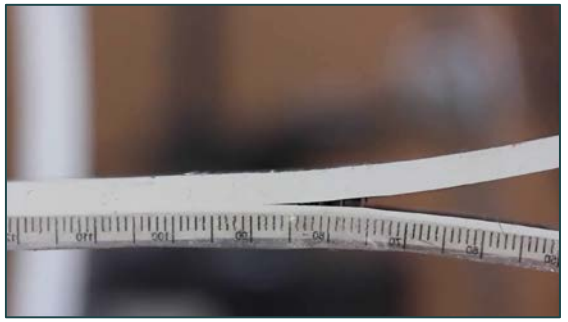
Design

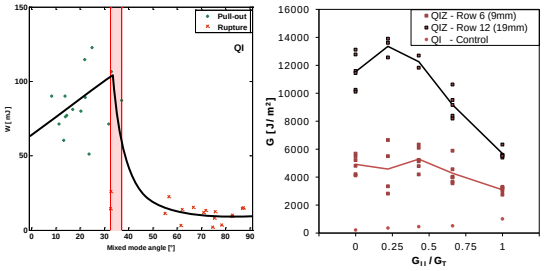




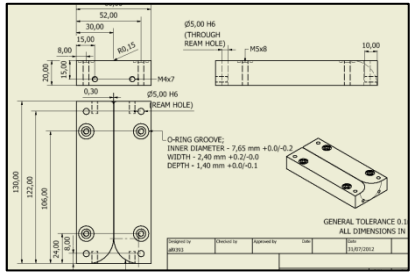


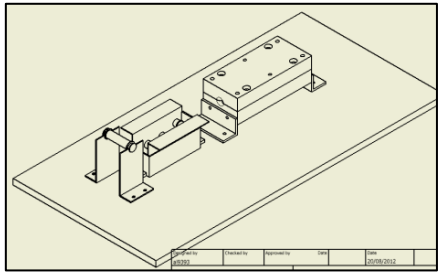
Test





Development





In the team: G. Mohamed, **M. Yasaee**, G. Allegri, S.R. Hallett, I. Partridge, M.R. Wisnom

University of BRISTOL

Imperial College London

HiPerDuCT
Programme Grant

Novel architectures for ductility in high performance composites

Dr. Gergely Czél

PI: Prof. Michael Wisnom

EPSRC
Engineering and Physical Sciences Research Council

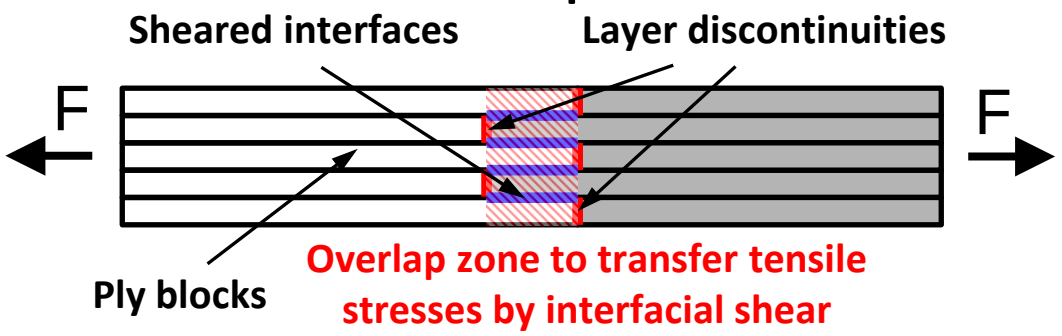
www.bris.ac.uk/composites

accis
ADVANCED COMPOSITES CENTRE FOR INNOVATION & SCIENCE

Ductility in discontinuous UD carbon/epoxy prepreg composites

Gergely Czél - g.czel@bristol.ac.uk

Concept



Micrograph of the alignment of ply blocks

Tensile test results

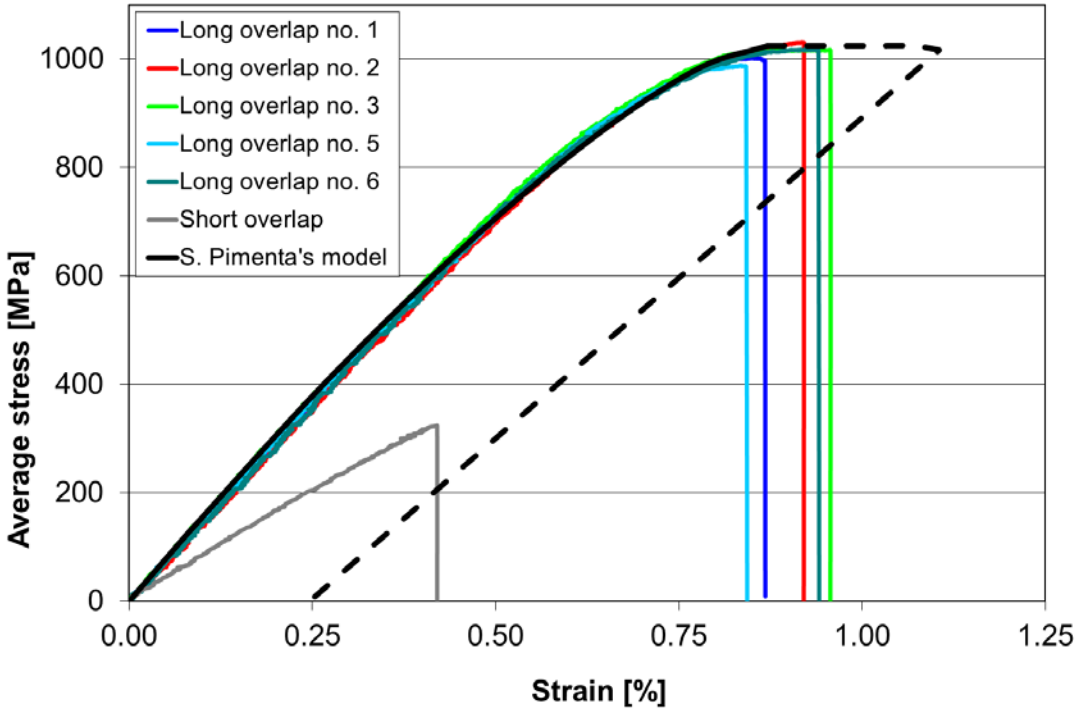
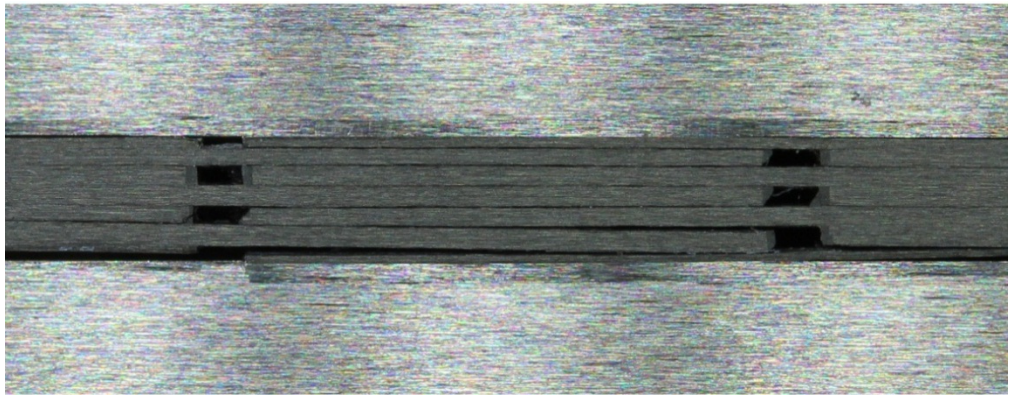


Image of the failed specimen



University of BRISTOL

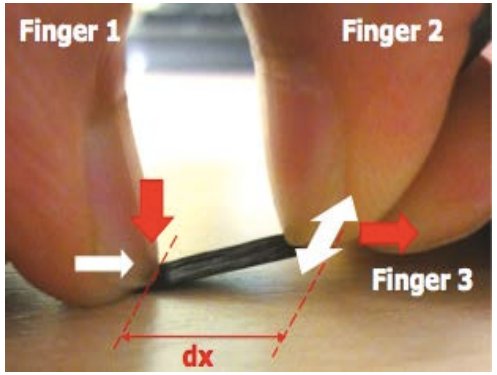
A novel tow steering technology - CTS (Continuous Tow Shearing)

Dr. Eric (Byung Chul) Kim

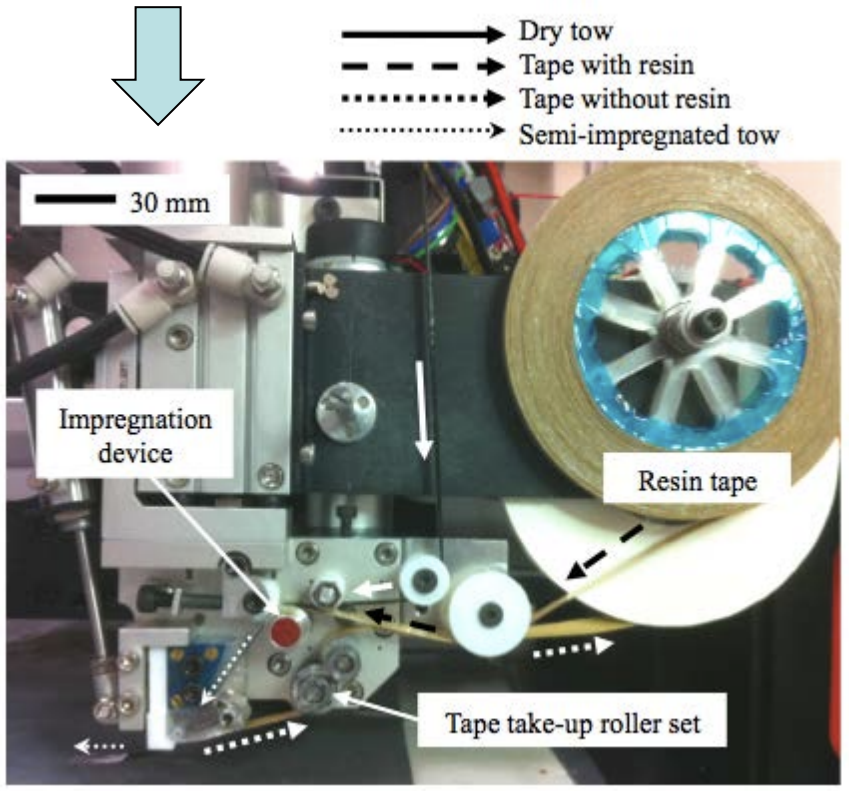
ADVANCED COMPOSITES CENTRE FOR INNOVATION & SCIENCE

CTS (Continuous Tow Shearing)

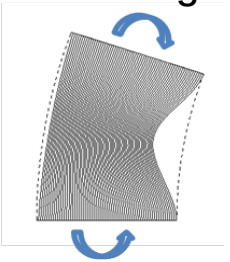
Eric (Byung Chul) Kim - b.c.eric.kim@bristol.ac.uk

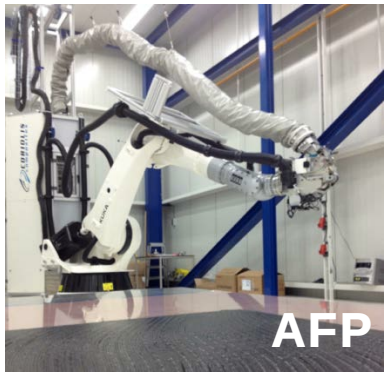


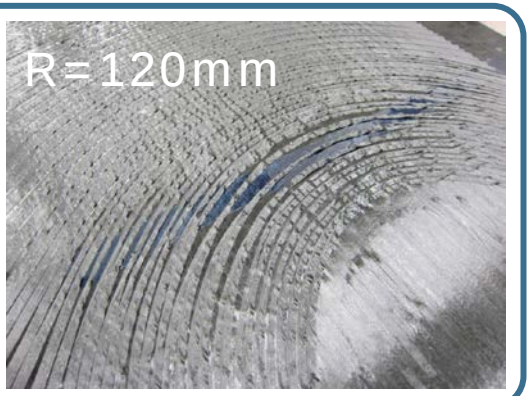
A novel tow steering technique minimising process-induced defects (fibre wrinkles, tow overlaps and tow gaps) by using in-plane shear deformation of the tow material rather than in-plane bending deformation used in conventional AFPs.



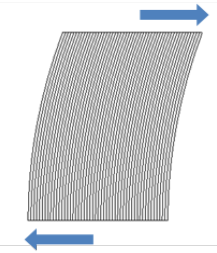
In-plane bending

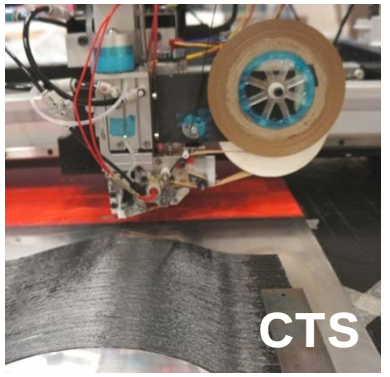






In-plane shear





University of BRISTOL

Imperial College London

HiPerDuCT
Programme Grant

Analysis of damage for UD hybrids

Dr. Meisam Jalalvand

PI: Prof. Michael Wisnom

EPSRC
Engineering and Physical Sciences Research Council

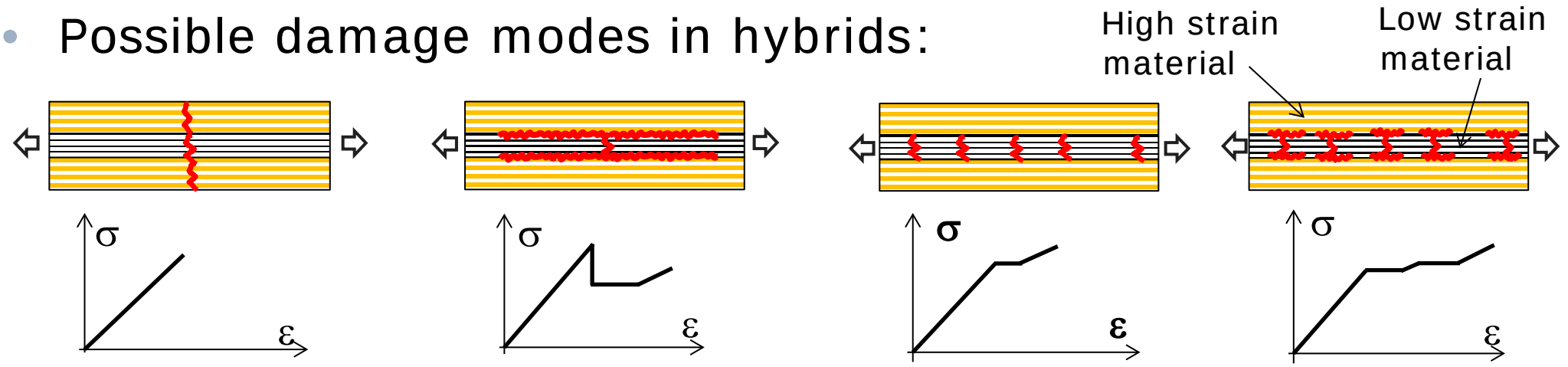
www.bris.ac.uk/composites

accis
ADVANCED COMPOSITES CENTRE FOR INNOVATION & SCIENCE

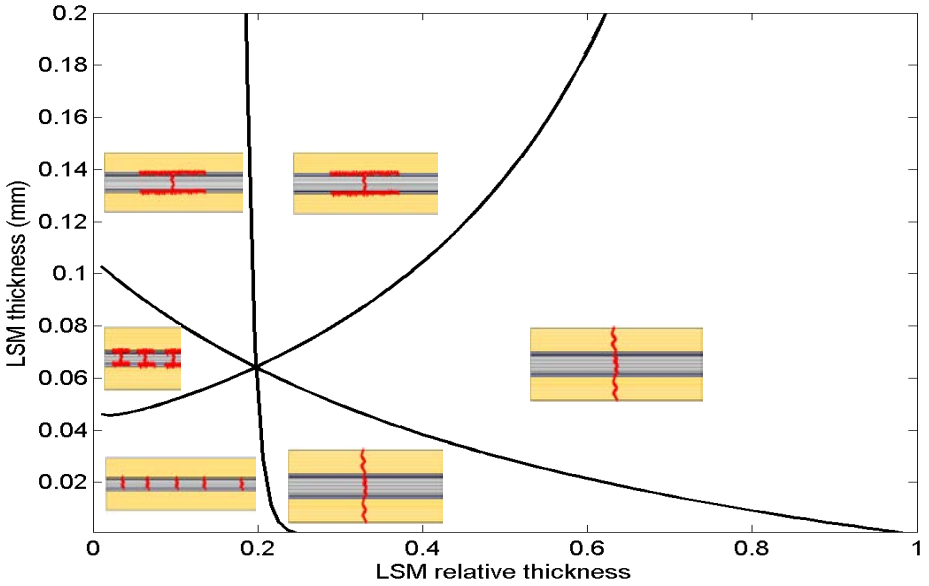
Analysis of damage for UD hybrids

Meisam Jalalvand - m.jalalvand@bristol.ac.uk

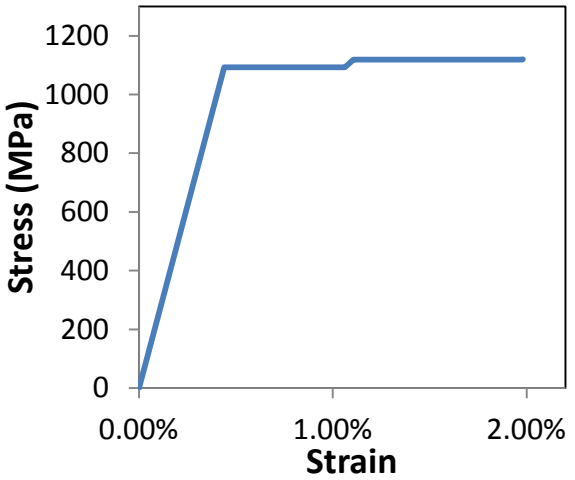
- Possible damage modes in hybrids:



- Damage mode map



- High strength / High modulus carbon hybrid



University of BRISTOL

Modelling of Variable Angle Tow Composite Structures

Dr. Zhangming Wu

PI: Prof. Paul Weaver

www.bris.ac.uk/composites

accis
ADVANCED COMPOSITES CENTRE FOR INNOVATION & SCIENCE

Modelling of Variable Angle Tow Composite Structures

Zhangming Wu - z.wu@bristol.ac.uk

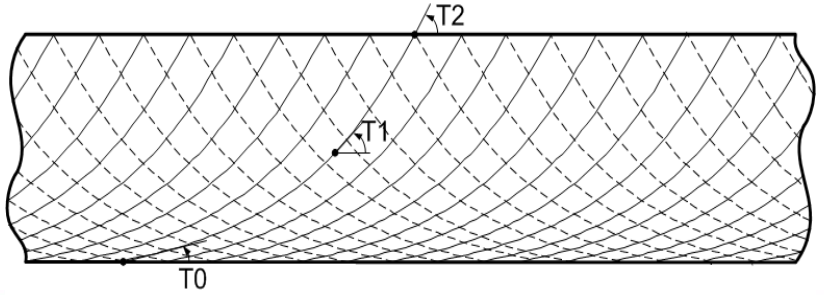
Aim: Efficient modelling and optimisation tools for the design of Variable Angle Tow composite structures.

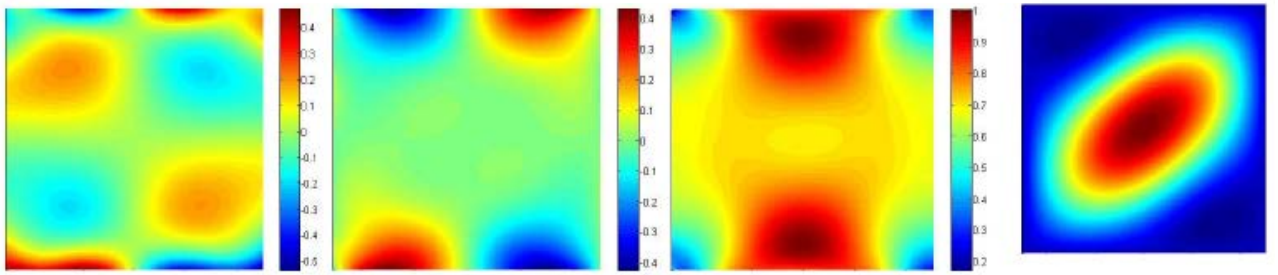
Modelling

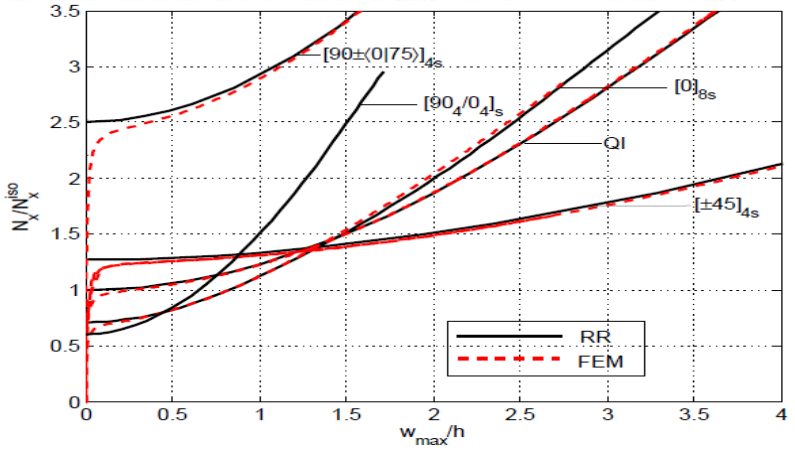
Prebuckling, Buckling and Postbuckling analysis of VAT composites:

- Variational Principle (Rayleigh-Ritz method).
- Differential Quadrature Method

Accurate, Robust & Fast







University of BRISTOL

Imperial College London

HiPerDuCT
Programme Grant

A Novel Manufacturing Method for Aligned Discontinuous Fibre Composites

Dr. HaNa Yu

PI: Prof. Kevin Potter

EPSRC
Engineering and Physical Sciences Research Council

www.bris.ac.uk/composites

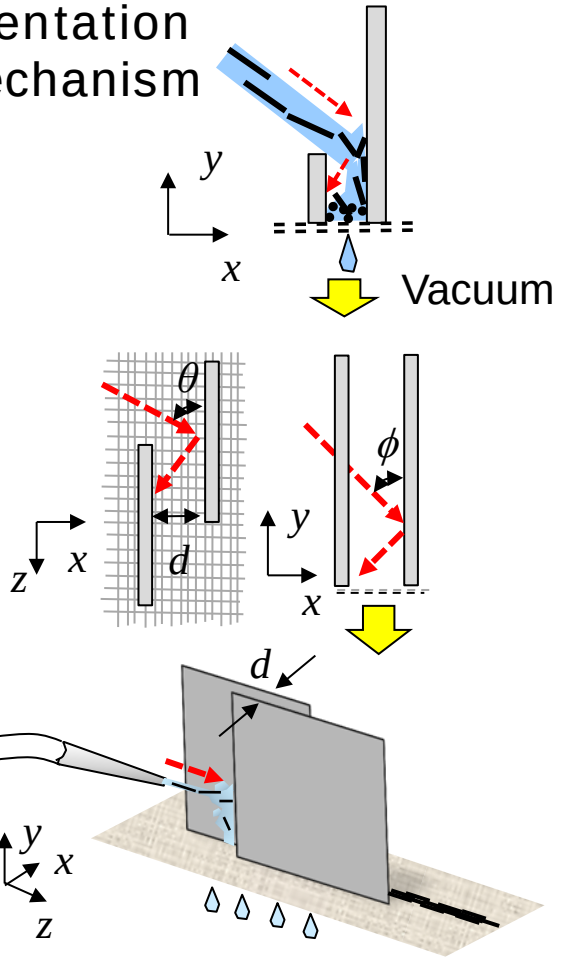
accis
ADVANCED COMPOSITES CENTRE FOR INNOVATION & SCIENCE

Aligned Short Fibre Composites

HaNa Yu - Hana.Yu@bristol.ac.uk

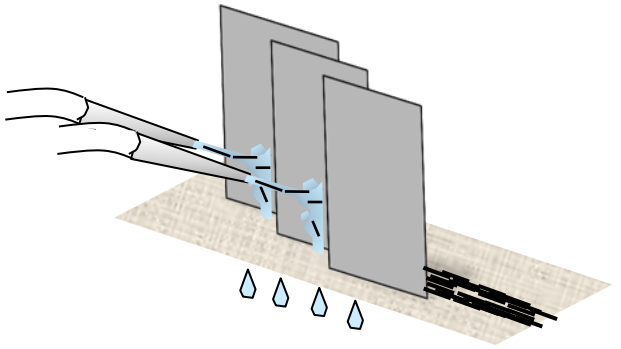
- **Key challenge:** Development of a novel manufacturing method of **aligned short fibre composite** for high performance **ductile response**

1. Develop a fibre orientation mechanism

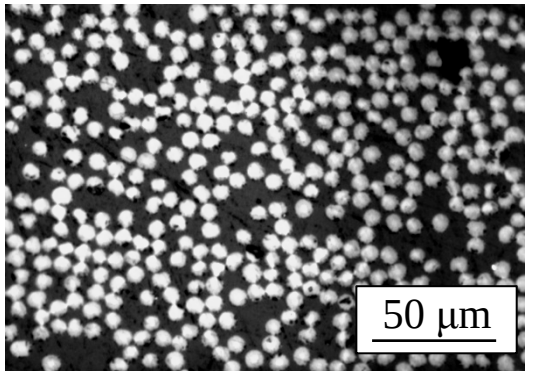


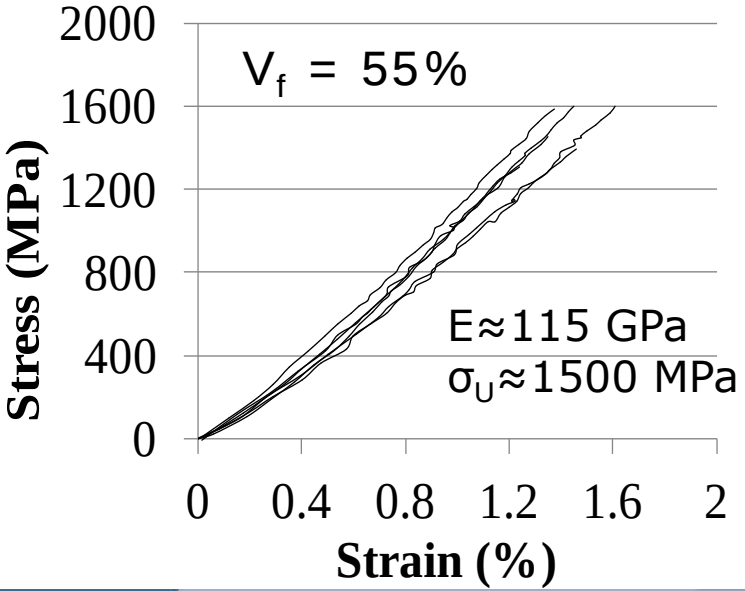
2. Build up a prototype module

Suspending fluid: Water
Fibre: 3 mm long carbon fibres
Resin: Epoxy resin film



3.Tensile test results





University of BRISTOL

Design and optimization of variable angle tow composite plates

Dr. Gangadharan Raju

PI: Prof. Paul Weaver

www.bris.ac.uk/composites

accis
ADVANCED COMPOSITES CENTRE FOR INNOVATION & SCIENCE

Design and Optimisation of Variable Angle Tow (VAT) Composite Plates

Gangadharan Raju - gangadharan.raju@bristol.ac.uk

Objective:

To develop a robust optimisation framework for design of VAT plates to maximise buckling and post-buckling performance

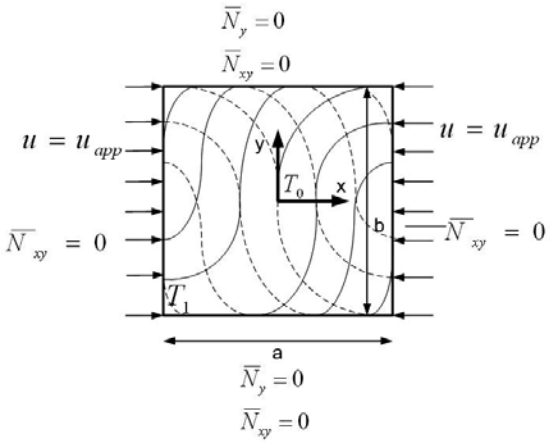
Optimisation tools:

Developed a two-level optimisation strategy

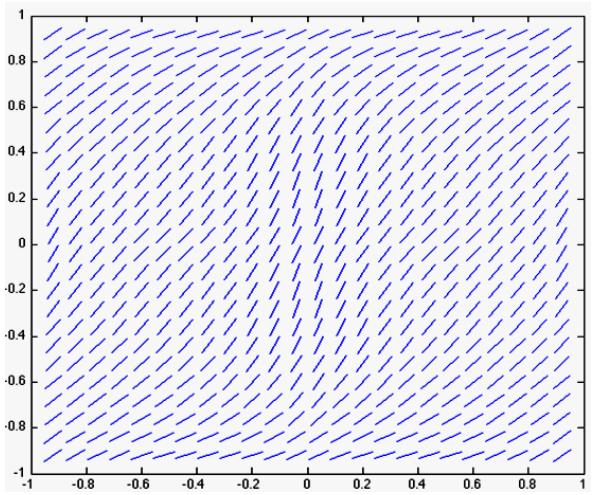
i) Method of moving asymptotes: determine optimal lamination parameters distribution

ii) Genetic algorithm: determine fibre distribution

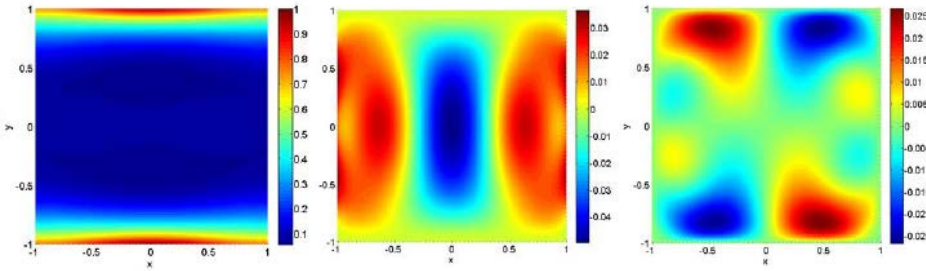
Results:



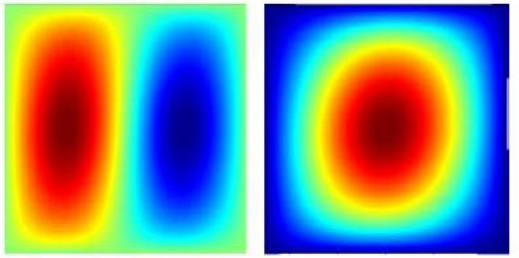
Optimal distribution of fibre angles



Stress resultant distributions



Buckling mode shape



$K_x = 3.71$ (165%) increase

In the team: Gangadharan Raju, Zhangming Wu, Prof. Paul Weaver

University of BRISTOL

Feasibility of Pad Printing For Use in Advanced Composite Manufacturing

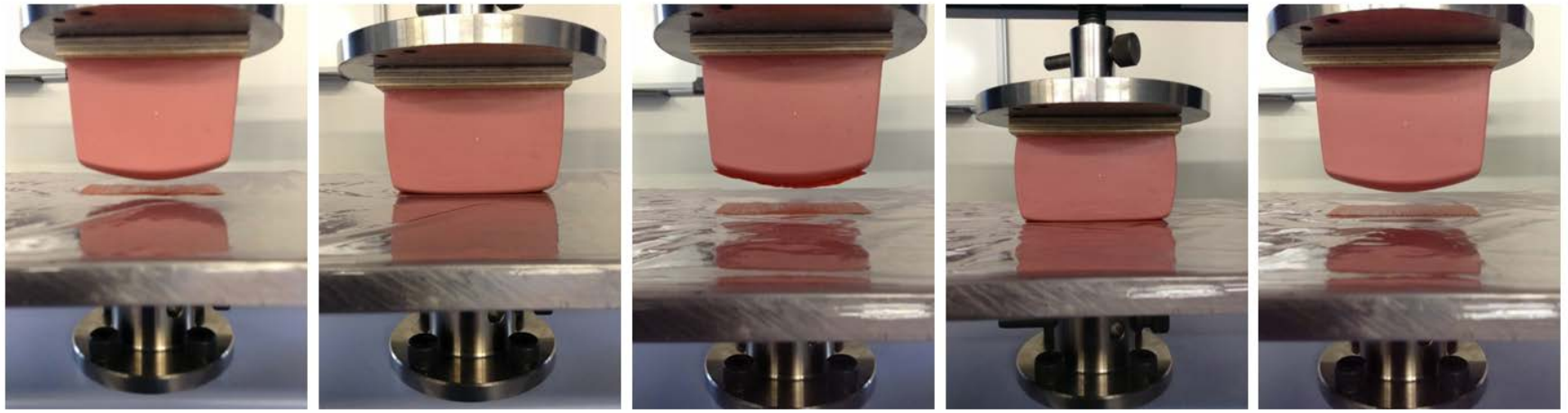
Dr. Julie Etches,

Dr. Carwyn Ward, Josh Roberts

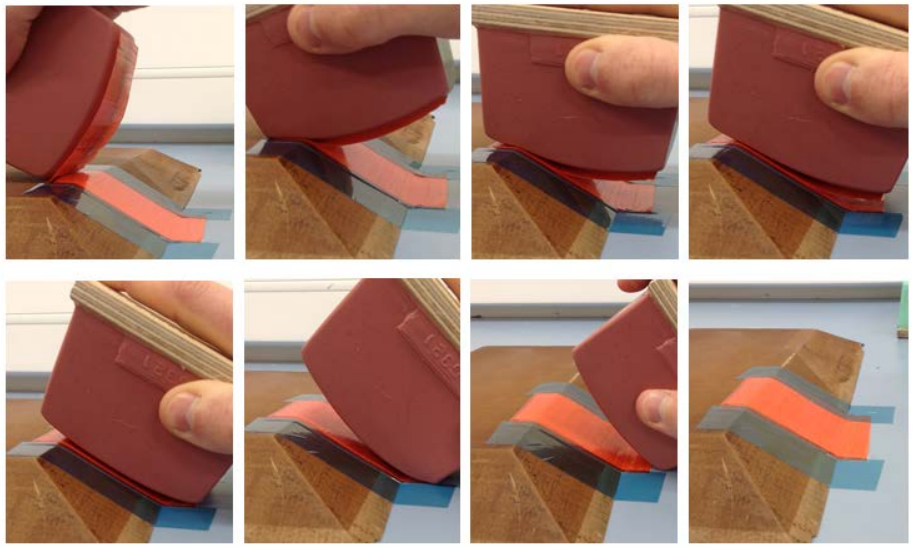
www.bris.ac.uk/composites

accis
ADVANCED COMPOSITES CENTRE FOR INNOVATION & SCIENCE

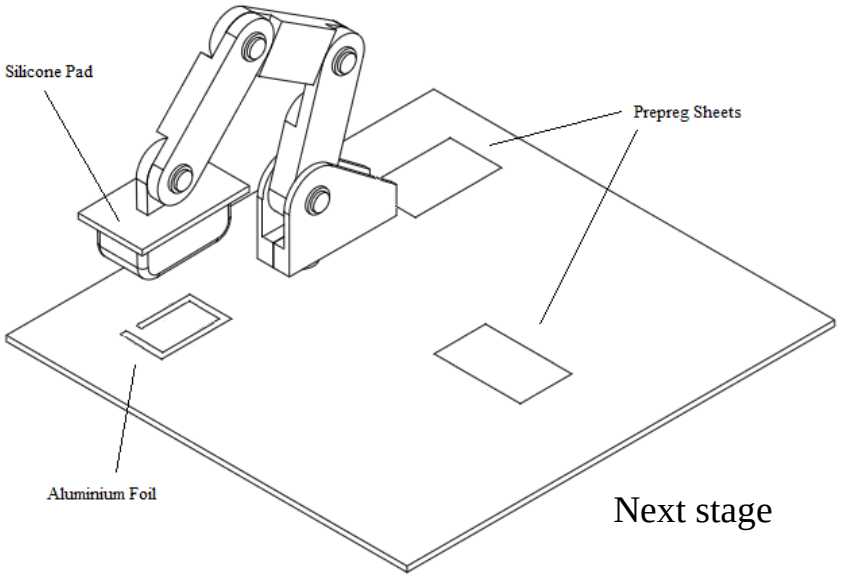
Prepreg Pad Print Concept



Pick-up and Place using Small rectangular Pad



Process of Rolling Prepreg over Complex Geometry from Left to Right



Next stage