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Technologies framework for Automated Dry Fibre Placement (ADFP)

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Technologies framework for Automated Dry Fibre Placement

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- Background
- Opportunities
- Challenges
- Initial programme
- Opportunities for involvement

Background

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Quoting from the proposal

The emergence of Automated Dry Fibre Placement (ADFP), where dry fibre tows are retained by a polymer binder, provides capability to exploit the advantages of resin infusion to form highly complicated and integrated parts with the versatility and repeatability of AFP.

ADFP is a relatively new technology and many challenges remain, primarily around the fundamental understanding of the materials, effects of processing parameters and the influence of tailored preforms on infusion.

Key to the development of ADFP is the ability to accurately predict optimal processing windows for a given range of parameters, eg. temperature, feed rate and compaction pressure.

We will also be looking at dry fibre approaches beyond “conventional” DFAFP

Opportunities

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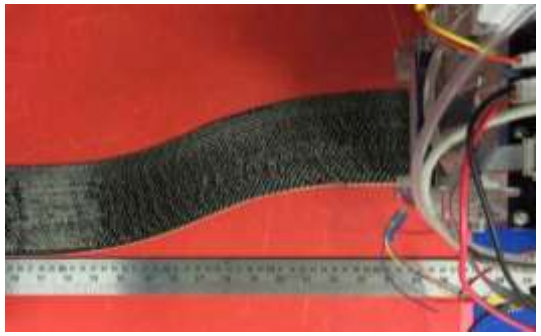
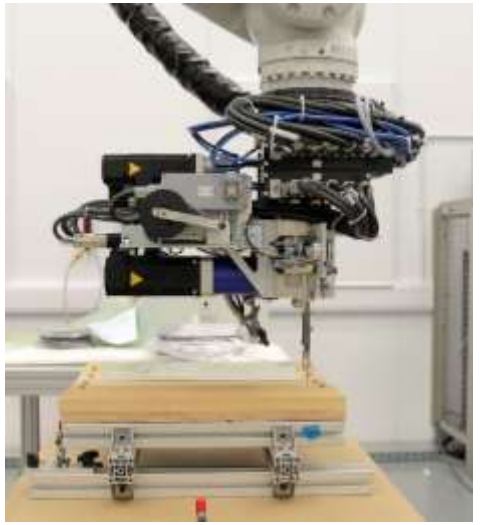
Dry fibre AFP offers the potential for

- Significantly improved capability to “steer” fibres
- The potential to integrate tufting or stitching for complex preform integration
- The possibility to design in flow channels or vascular structures
- Increasing the rate of deposition





Challenges

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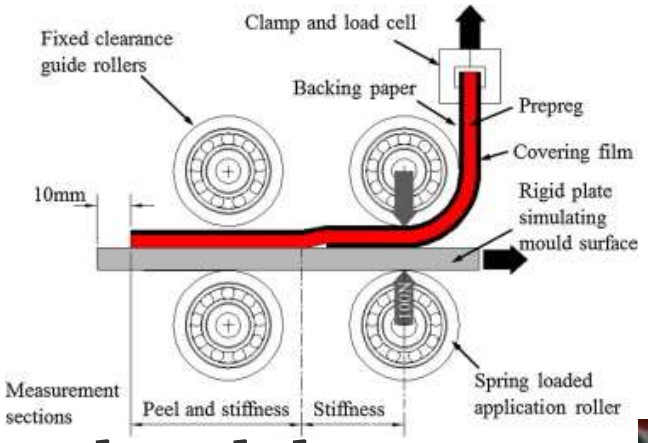
We need to understand



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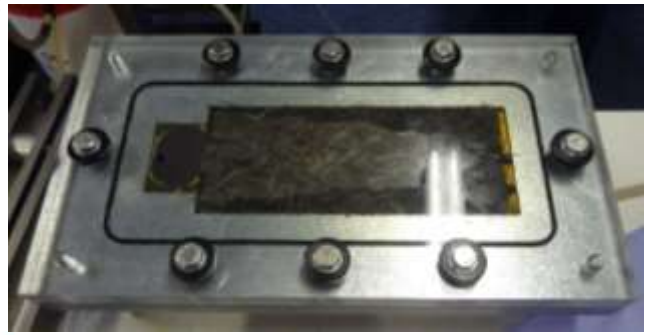
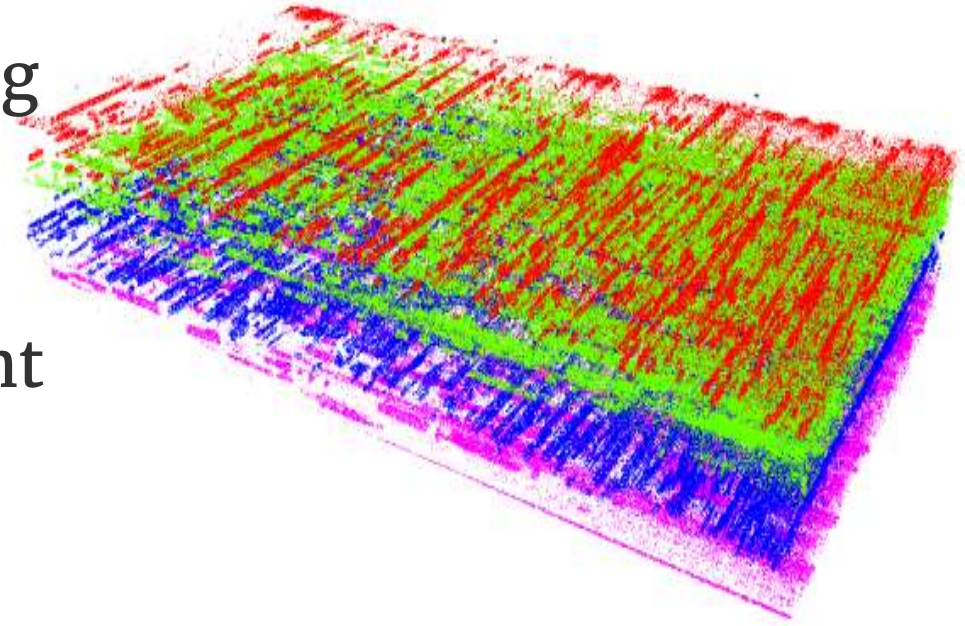
How to optimise binders

The deformation mechanics of bound and dry tows



Origins and impacts of defects in DFAFP

Understanding the effects of tow steering



Cost modelling & process design

Permeability control & flow enhancement

We need to understand

Integrating preforms

Postforming of tailored blanks

Deposition rate improvements

DFP machinery

Developing beyond DFAFP

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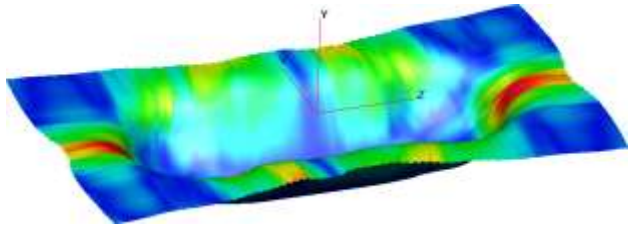

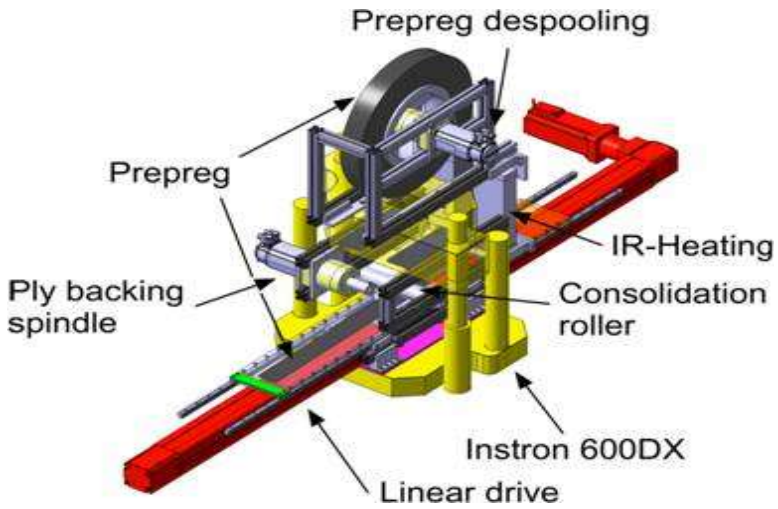

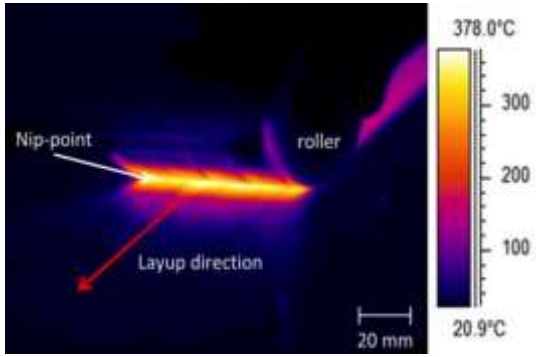

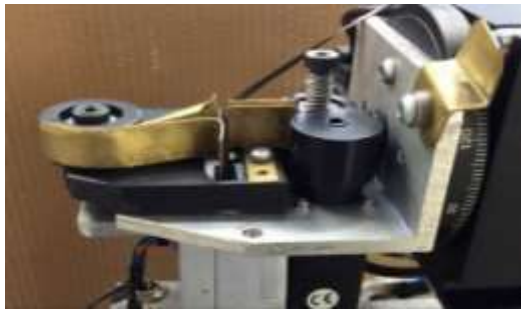

Initial programme

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Programme is currently under development based on prior experience and expertise at Bristol and Nottingham including

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Access to AFP experimental simulation equipment and commercial AFP

Testing facilities

Permeability testing & flow simulation strength

Tack testing background

Process automation experience

Dealing with dry fibres & integrated preforming approaches

Bristol initial emphasis

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Minimum cost DFAFP – binder application on the fly

In-process inspection for defect formation

Steered preform quality assessment

Production line / cost modelling

Integrating DFAFP with woven or NCF in complex preforms

Resin issues

Nottingham initial emphasis

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PhD 1 – Process architecture

- High rate / low cost processes - feasibility assessment
- Integrated process development – cost and performance potential

PhD 2 – Material design & deposition

- Fabric / tow compaction & deformation mechanics
- Permeability & liquid resin processes- engineered flow control
- Material optimisation for deposition - Tack testing

Opportunities for involvement

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Potential work packages

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Process design

- Establish requirements for next generation structures
- Establish rate limiting factors in deposition processes
- Process architecture alternatives
- Cost modelling

Material design & deposition mechanics

- Alternative material formats
- Binder issues & tack
- Dry tow deformation

Laminate design

- Permeability issues & permeability control
- Defect analysis

Industrial input

It is important to note that this is an EPSRC funded research programme aiming at developing a fundamental understanding of advanced dry fibre processing techniques so the core activity will be an academic programme at low TRL.

We are very keen to have industrial input as to what are seen as the key challenges from an industry viewpoint requiring fundamental understanding.

If industry partners have specific targets then at low TRL these can be tackled via sponsorship of PhD students and at higher TRL via the EngD scheme.

We would strongly encourage industry partners to get involved in the project as it develops.

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