Manufacturing and Design Theme - 2017

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Our research centres around Design for Manufacture, from novel material forms that facilitate forming, through detailed process understanding and novel machines to factory operations.
Highlights of 2017

• IDC in Composites Manufacturing now stands at 31 students in 12 companies supervised from 4 universities
• First IDC EngD student just graduated
• 20 Journal papers published from the group
• 12 papers from the group at ICCM 21, plus other conference papers
• Future Composites Manufacturing Hub launched
• >£1M EPSRC programme to scale up the short fibre alignment technology – HiPerDif - lead in the collaboration passed to Materials Group
Highlights of 2017

• ATI/EPSRC pump-priming projects supporting ATI Future Aerostructures Targets completed and reported

• Collaborative Programme Grant proposal being developed based on one of those projects with other proposals under consideration

• Working with the ATI and the other university recipients of ATI/EPSRC pump-priming funding to map out a route forward on Hybrid/electric aircraft

• Eric Kim awarded EPSRC First Grant

• Increasing international links are being developed through visits and joint papers
In-Process visualisation

• We are increasingly focused on visualising the way in which the composite’s structure changes during cure.
• Much of this work is aimed at understanding the origins and development of voidage during cure.
• We have developed methods to identify both the area and volume of voids at the tool surface
• We have investigated the influence of prepreg surface topology
• We have developed a method to use CT scanning through cure to map void volume throughout the process
• We are looking at pressure mapping to give us additional information through manufacture
Prepreg Contact Against Glass

Currently capable of capturing/analysing surface void area, but not the behaviour of individual voids

8552-IM7

M21-IMA

1 min
1 h

After heating to 95°C

Images: 220 x 180 mm
Effect of Surface Roughness

HexPly 8552

Very Smooth

Hexply M21 – Interleaved

Blotchy
Optical Metrology Scanning

Developed a technique to observe prepreg surface against glass during vacuum bag processing

Experimental set-up
Void Volume Changes

Capture images (30s scan) through the process. Compare the results to a mass-pressure model. Initial pressure determines final void volume in the simulation.

In-Process Micro-CT

Opportunity to follow development of microstructural features through the manufacturing process. Investigated a gap between tow courses.

Fibre Placement Machine  Deposited material  Microstructure defects observed after cure

- Resin rich
- Voids
- Waviness
In-process Measurements

Pressure Mapping

Pressure distribution in nominally perfect material

Reclaimed fibre

Pristine UD fibre

Summary and Outlook

In-process measurement techniques can offer insights into material behaviour during processing and provide necessary input data and validation data for process modelling.

Up-scaling technologies to industrial processes is a challenge, but progress is being made on several fronts.

Close collaboration with modelling community and with the NCC Core Research Programme is important to accelerate adoption within industry.