Development of low-cost multifunctional carbon-fibre composite aerostructures incorporating carbon nanotubes

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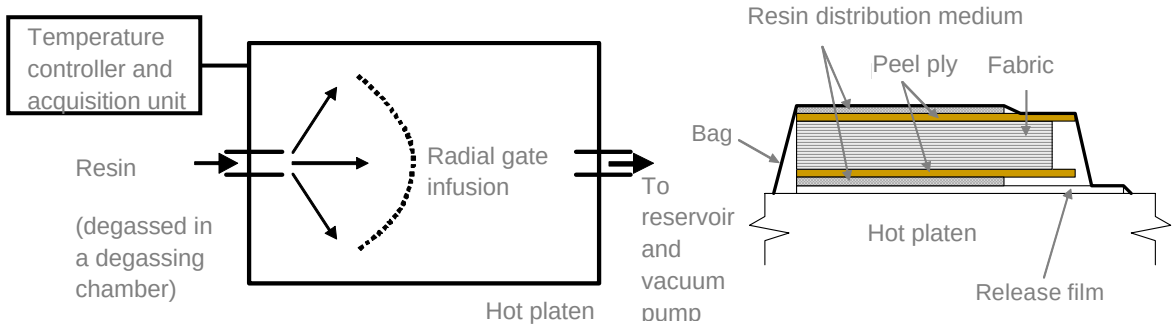
Background

The 'Achillies Heel' of composites is their relatively poor through-thickness strength. Their fracture toughness and interlaminar shear strength may be significantly improved by dispersing small amounts of carbon nanotubes into the resin prior to injection. There are a number of process parameters which need to be identified and controlled to achieve the required structural integrity. The extent of improvement will primarily depend on the level of dispersion and beneficial nanotube alignment achieved.

The use of dispersed nanotubes further offers the potential of making the structure multifunctional. Changes in electrical conductivity offer the possibility of creating a self-sensing structure for damage detection as well as providing added lightning protection. The latter may be achieved my increasing the concentration of CNTs on the surface of the part to replace metallic meshes currently used on composite aircraft structures.



RIFT setup [Falzon & Donadon 2004].

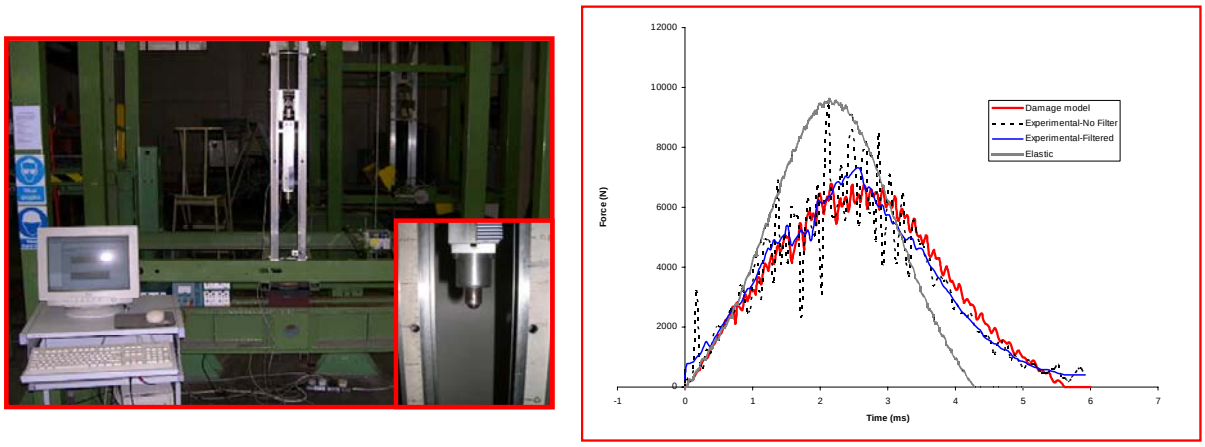
Proposed Research

A RIFT (Resin Infusion under Flexible Tooling) facility will be developed and an effective means of achieving alignment and dispersion of carbon nanotubes will be explored using a combination of mechanical and acoustic methods. Process modelling will also be undertaken to help optimise the infusion process. An experimental programme will be undertaken to assess the improvements in fracture

toughness achieved through the proposed nanotube dispersion and alignment methods.

The structural performance of the developed composite structures will be assessed by impact and compression-after-impact studies. This will also guide the further development of damage models previously developed for ABAQUS. The introduction of carbon nanotubes will influence the conductivity of the composite. A strategy will be developed for assessing the suitability of using CNTs for damage detection. The possibility of removing the need for a copper mesh to provide lightning protection will also be explored by the proper placement and concentration of carbon nanotubes.

This project will require two PhD candidates who will each concentrate on different aspects of the research programme.



Impact rig and force vs time response of impactor [Donadon *et al.* 2008].