PhD in Autonomous Systems and Connectivity (Composite materials)

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Multiscale modelling of damage mechanisms in composites

Aim : To develop a data-driven multiscale modelling framework for non-linear mechanisms in advanced composites

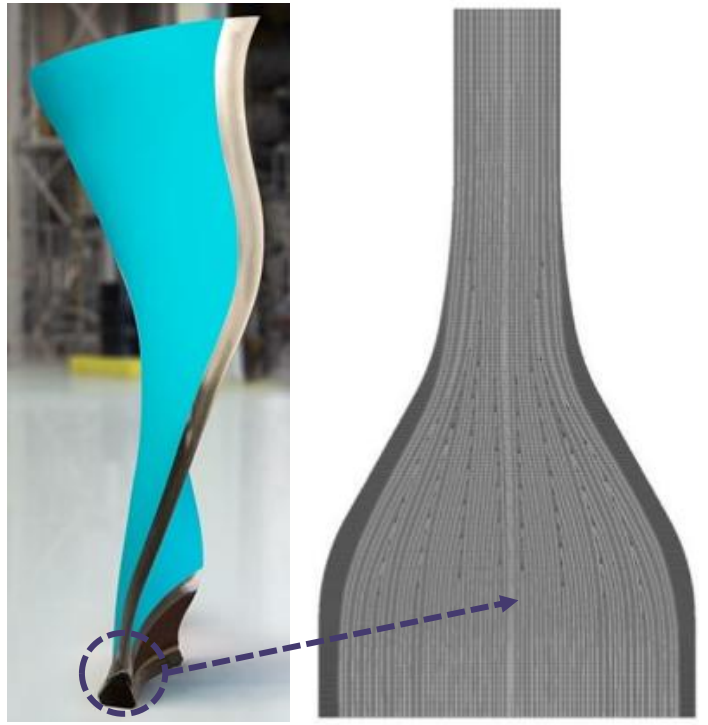
Objectives

- To build a hybrid data-driven multiscale model that can represent lower length-scale mechanisms accurately yet efficiently.
- To investigate and identify ways to implement thermodynamic consistency as a part of data-driven network.
- To demonstrate the developed method in large-scale structural response modelling

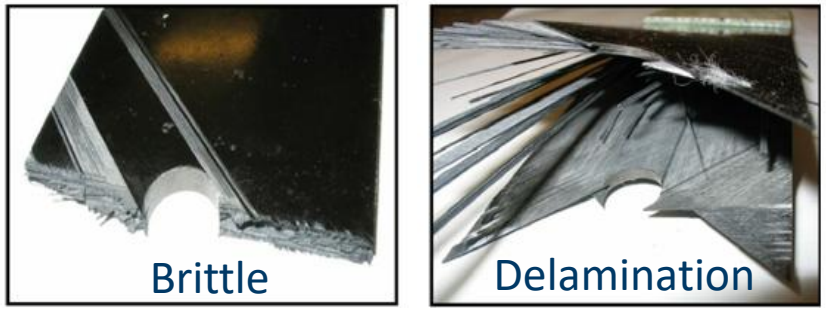
Project brief : Constitutive modelling with micromechanical response is essential to model architected materials such as composites. However, the limiting computational cost hinders the multiscale analysis. This project will focus on developing a neural-network based multiscale framework that satisfies Hill-Mandel condition, history and path dependency expected with damage. Novel ways to implement the derivatives involved and to satisfy the Dirichlet boundary conditions involved to minimise the error associated with the latent space dynamics.

Funding : Competitive Funding (Home/International) Deadline : 31st Jan 2026

Application Link



https://www.rolls-royce.com/ Composites Part A 133 (2020) 105862



Composites: Part A 40 (2009) 613–624

Process modelling of AFP to optimise composite manufacturing

Aim : To develop data-driven process modelling for composite manufacturing with Automated Fibre Placement (AFP)

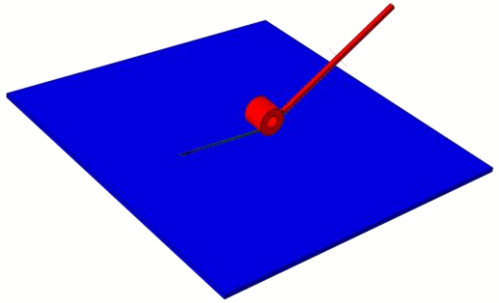
Objectives

- To demonstrate the ability to minimise manufacturing trails with digital modelling.
- To investigate the process evolution and manufacturing conditions on the structural behaviour
- To implement a multiscale process modelling that is accurate and computationally efficient.
- To perform mesoscale optimisation, consolidation studies to investigate part quality.

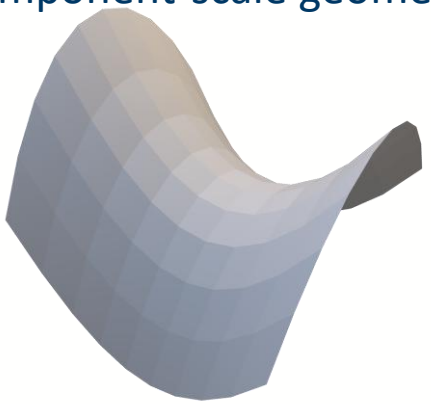
Project brief : Unlike conventional metal, composite materials exhibit variable behaviour under the processing conditions of temperature, pressure and compaction load leading to manufacturing defects that significantly affects the structural integrity. This project will focus on developing a unified framework to link materials -> process-> structure relationship that significantly improves the virtual manufacturing and testing capability.

Funding : Competitive Funding (Home/International) Deadline : 31st Jan 2026

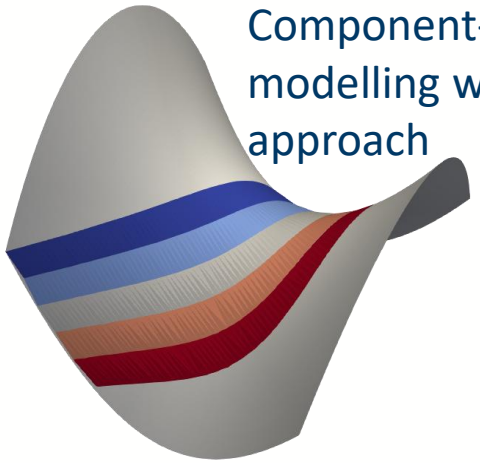
Ply-level FE model



Component-scale geometry



Component-scale process modelling with surrogate approach



Application Link