



**QUEEN'S
UNIVERSITY
BELFAST**



Using deep learning for predictive composites manufacturing process degradation



Project Aim:

The Resin Transfer Infusion (RFI) process, developed in Belfast for the production of the Airbus A220 wing, has been heavily instrumented and a substantial quantity of data has been generated over the years. One parameter which needs to be carefully monitored, in the production of these wings, is the level of porosity in the resulting resin-infused non-crimp-fabric (NCF) carbon fibre reinforced composite structure. On occasion a process degradation is observed through a commensurate increase in the measured porosity leading to part rejection when the volumetric porosity exceeds 2%.

The aim of this project is to use deep learning algorithms to mine existing data and investigate whether it is possible to predict process degradation so that corrective measures may be implemented before the level of porosity exceeds acceptable limits.

Objectives:

- Develop suitable data infrastructure environment to be able to create any necessary metadata representations to allowing development of suitable analytic algorithms
- Undertake initial quality assessment of the data to investigate and address any missingness and inconsistencies using suitable imputation techniques
- Undertake investigative analytical approaches which will act to reveal any dependencies within the data, that's revealing any relationships
- Explore ensemble methods for improving the predictive performance and reducing variability of the model in close collaboration with the company in order to gain a better understanding of the relationship of the manufacturing process

Advanced Composites Research Group



Key skills required for the post:

Candidate should demonstrate knowledge/experience/skills in at least two of the following areas:

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| <ul style="list-style-type: none"> • Deep learning/artificial intelligence • Data Analytics • Computational modelling | <ul style="list-style-type: none"> • Composite Materials and Structures • Composite manufacturing • Aircraft structures |
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Key transferable skills that will be developed during the PhD:

These will include an ability to effectively communicate research outcomes to academic peers and industry, independent analytical thinking and problem solving, time management, and leadership.

Lead supervisor:

Dr Jialie (Jerry) Shen
School of Electronics, Electrical Engineering and Computer Science
j.shen@qub.ac.uk

Other supervisors:

Prof Brian G. Falzon CEng FRAeS
Professor of Composite Materials and Aerostructures
Head of School, b.falzon@qub.ac.uk

Prof Roger Woods
School of Electronics, Electrical Engineering and Computer Science
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Funding mechanism:

UK nationals only.

Application closing date:

31st July 2021

Guaranteed stipend

£15,285 tax free.

PhD students in the School may have the opportunity to apply to be demonstrators on undergraduate modules. Compensation for this can amount to in excess of £2,400 per year.

Queens University Belfast is a diverse and international institution which is strongly committed to equality and diversity, and to selection on merit. Currently women are under-represented in research positions in the School and accordingly applications from women are particularly welcome.