

QUB- Mechanical and Aerospace Engineering

PhD Project 2021-22



**QUEEN'S
UNIVERSITY
BELFAST**



Cyber - physical methods for the design and process verification of complex composite aerostructures



Project Aim:

The aim of this project will be to develop innovative, cyber-physical methods for the design and process verification of major structural elements of composite aerostructures. Ideally, product and process verification would need to take place during the design stages, in order to reduce time-consuming and expensive physical testing, reduce the time for process capability enhancement via repeated production runs, eliminate quality failures and avoid expensive post-production rectification of faults.

Cyber verification is underpinned by specialist computational techniques to allow the verification of key elements of the digital model in terms of their surface texture (waviness and roughness), geometric characteristics (form, location and orientation) and dimensional characteristics.

By modelling the process capability of the manufacturing processes deployed, modelling the propagation of dimensional and geometric variability introduced during fabrication and assembly, and estimating the measurement uncertainty of metrology equipment used throughout the process, it will be possible to estimate how the engineering specifications of a structure will differ from the design intent within the digital/cyber environment. This will allow a range of design configurations and specifications, as well as different processing, fabrication and measurement options to be evaluated in order to select optimal processes and fabrication methods as well as streamline the specification of physical verification and testing requirements.

Objectives:

- Investigate new techniques that will allow design verification for complex structural elements to take place as early in the design time cycle as may be feasible.
- Investigate technology options for in-process and post-process verification for the new composites manufacturing and fabrication processes deployed for producing major structural elements.
- Develop a procedure for measurement and verification technologies rating, evaluation and down selection.
- Develop digital models and algorithms for the selected measurement and verification technologies that include measurement uncertainty estimations.
- Develop a novel cyber - physical, technology demonstrator for verification.

Advanced Composites Research Group



Key skills required for the post:

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

- Computational modelling
- Aircraft structures

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:

Prof Paul Maropoulos
Professor of Advanced Manufacturing
AMIC Director, p.maropoulos@qub.ac.uk

Other supervisors:

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

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.