QUB- Mechanical and Aerospace Engineering

PhD Project 2021-22

High temperature composite nacelle structure

Project Aim:

Spirit AeroSystems is a major nacelle manufacturer and is facing considerable competition from international competitors. The emergence of ultra-high bypass powerplants has necessitated the development of large nacelle structures and, consequently, the need to make these structures lighter has never been greater.

Spirit AeroSystems would like to design a new class of nacelles which make greater use of carbon-fibre composite materials. There are considerable challenges that must be overcome. For example, the inner fixed structure, which is currently made from a metallic sandwich structure, with acoustic features to attenuate noise, is subjected to higher temperatures than current epoxy resins can withstand. High temperature epoxies do exist but these need to be characterised and evaluated on both performance and cost. Another challenge is ensuring that in the event of a catastrophic failure arising from a burst duct (as happened to the QANTAS A380 Rolls-Royce Trent 900 Engine, in November 2010 on flight QF32) the ensuing damage is contained and does not result in the complete disintegration of the engine with the potential loss of the aircraft. While the QF32 incident was a rare occurrence, and the breach happened to a predominately metallic nacelle, similar incidences occurring in a nacelle structure with a higher level of composite material, must be shown to contain such failures.

Objectives:

- Undertake a performance/cost analysis of high temperature epoxy composites
- Material characterisation study of potential candidates for the face sheets and core
- Acquisition of material data required for virtual testing
- Assessment of bonding composite face sheets (with acoustic perforations) to core and subjected to high temperature operating conditions
- Acoustic and energy absorption studies using flat sandwich panels
- Digital twin development for virtual testing of burst duct event.

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
- Basic material characterisation/testing
- Basic material selection

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 Brian G. Falzon CEng FRAeS Professor of Composite Materials and Aerostructures Head of School, b.falzon@qub.ac.uk
Other supervisors:	Dr Ali Aravand m.aravand@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.