

# QUB - Mechanical and Aerospace Engineering PhD Project 2019-2020

**Title: Modelling Aircraft Fatigue Load Spectra and the Effect of Novel Aircraft Designs**

**Project description:**

This project is funded through a prestigious EPSRC iCASE award and will be carried out within a large research team (including academics, PhDs and Post-Doctoral researchers) who conduct exciting and innovative research in collaboration with Rolls-Royce. It will investigate novel computational methods for modelling and assessing the impact of fatigue loading considering nonlinear load cases on critical structures associated with current and future engine and aircraft design concepts.

Fatigue load modelling is a major interest for the aviation industry, as these loads often determine the lifespan of equipment and hence directly influence the life-cycle cost of aviation products. As such, a proper understanding of fatigue loading, and the ability to rapidly model its variation and understand the consequences on the design, could provide extremely beneficial information to the aircraft design process. Fatigue loads are a function of:

**Aircraft operation**

The flight operation of a vehicle can have a first order effect on the fatigue life usage of key systems, for example short haul aircraft will take-off and land much more frequently than long-haul vehicles. Capabilities will be developed to model different flight profiles and usage models.

**Aircraft flight dynamics**

The aerodynamic behaviour of the aircraft to transient effects such as gusts results in changes in loading within the aircraft. Standard reduced order modelling approaches can fail to accurately predict the aerodynamic loads both at subsonic and transonic speeds. Tools for accurately modelling and assessing transient effects (i.e. gust loads) on different design philosophies will be investigated.

**Aircraft design considerations** [such as gust response control systems].

Additional systems can be applied to aircraft in order to reduce fatigue loading on aero-structures. New tools will be developed to model such systems.

**Aims and Objectives:**

This project will investigate the development of appropriate tools for modelling the effect of fatigue loading on an aircraft.

The objectives will be to:

- Perform a review of methodologies for developing fatigue spectra.
- Determine how the spectra are influenced by operations, aircraft flight dynamics and emerging fatigue relieving technologies to understand the driving parameters.
- Create a framework to calculate the impact of these spectra on the power plant assembly to understand the influence on component weight and operating life.
- Study fatigue effects due to operation and flight dynamics (gust) on novel aircraft designs
- Assess the impact of any emerging fatigue relieving technologies.

As part of the project you will engage regularly with other members of the team and have frequent meetings with Rolls-Royce engineers.

**Key skills required for the post:** Knowledge of computational analysis methods for structural (FEA) and fluids (CFD)

**Key transferable skills that will be developed during the PhD:**

**Lead supervisor:**

Prof Adrian Murphy, Dr Marco Geron

<b>Other supervisor(s):</b>	
<b>Guaranteed stipend:</b>	Approx. £18,250
<b>Conditional top-up available:</b>	
<b>PhD students in the School have the opportunity to apply to be demonstrators on undergraduate modules. Compensation for this can amount to in excess of £2,400 per year.</b>	

***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.***