Queen's Doctoral Training Programme on
Secure Connected Intelligent Design and Manufacturing

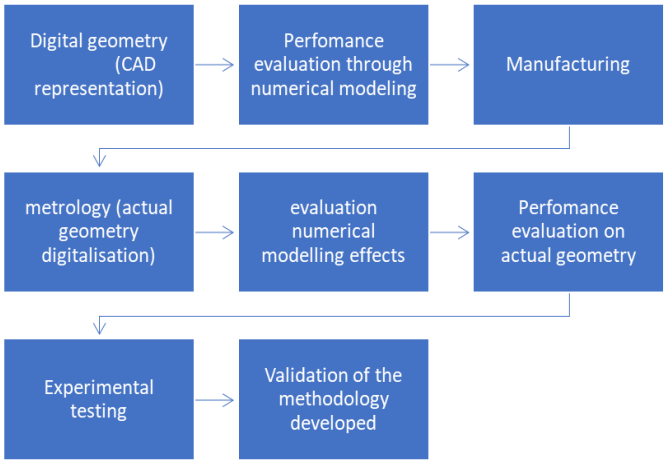
Title: DTP: Integration of Computational Fluid dynamics modelling and metrology to understand how uncertainty (manufacturing and modelling) can affect nozzles manufacturing and their performance.

This project is part of the Queen's Doctoral Training Programme in Secure Connected Intelligent Design and Manufacturing. Many of today's industrial approaches require transformative changes to ensure long term societal, economic and environmental resilience and sustainability. PhD projects in this programme explore the potential of emerging digital technologies, such as artificial intelligence, robotics, and the Internet of Things, to transform the way we design, manufacture and operate products and services.

Project description:

Tolerance and uncertainty due to imperfections and/or measurements is part of the manufacturing process. High performance industries such as industries in the aerospace sector, usually have strict limits on tolerance which are defined by empirical correlations derived from testing. However, these strict limits can substantially drive up the cost for manufacturing.
Therefore, the purpose of this project is to investigate the feasibility of developing a holistic approach that allows to correlate the uncertainty related to the manufacturing process (through metrology), with the uncertainty of the modelling approach (CFD) in order to understand and quantify how this uncertainty can affect the overall performance of the manufactured component (nozzles).
The final purpose of the PhD would be to develop, utilising an artificial intelligence approach, a numerical based evidence model that could allow to redefine tolerance limits and possibly relax them reducing the cost without affecting the component performance.

A possible methodological approach to the project is sketched on the figure below.



Aims and Objectives:
Different objectives are envisaged in this research project:

- To understand and quantify how manufactory can affect the digital geometry (CAD)
- To understand what the effect of the actual (manufactured) geometry on the performance of the components is.
- To understand what level of fidelity is required by the numerical models to properly capture the effects of the actual geometry
- To understand how much tolerance can be relaxed before having a sensible decay on performance (this can allow to reduce cost by improving producibility).

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- To investigate the possibility to reduce (minimise) the number of experimental tests necessary for validation using high-fidelity numerical models

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<tr><td colspan="2">Key skills required for the post: Critical analysis, numerical modelling and problem solving.</td></tr>
<tr><td colspan="2">Key transferable skills that will be developed during the PhD:
The programme offers a bespoke research and training programme that aims to develop students into cross-disciplinary, industry-conscious thinkers and leaders who will influence the roadmaps of future advanced manufacturing technologies and their applications. They will have a balanced understanding of ICT (security, communications and data analytics) in the context of their application to Advanced Manufacturing and High Value Design.</td></tr>
<tr><td>Lead supervisor:</td><td>Dr Marco Geron, School of Mechanical and Aerospace. Email, m.geron@qub.ac.uk; Tel: 02890974728</td></tr>
<tr><td>Other supervisor(s):</td><td>Prof Paul Maropoulos School of Mechanical and Aerospace. Email, paul.maropoulos@qub.ac.uk ; Tel: 02890974728</td></tr>
<tr><td>Guaranteed stipend:</td><td>This is a 3.5 year funded Queen’s DfE DTPs studentship with Training Grant, to commence on 1 October 2020 (N.B. stipend for 20/21 is not yet known, but is likely to exceed £15,000). The studentship covers fees and maintenance and is available for UK residents (see full eligibility criteria - nationality, residency, and academic qualification at: http://go.qub.ac.uk/dfeterms).
When applying using the Queen’s portal please ensure you include “DTP:” along with the project title.</td></tr>
<tr><td>Conditional top-up available:</td><td></td></tr>
<tr><td colspan="2">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.</td></tr>
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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.