

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

Title: DTP: Soft sensing for in-process optimal quality control for remote laser welding processes	
<p>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.</p>	
<p>Project description: Complex manufacturing systems such as remote laser welding processes involve many interdependent process variables, and operators faced with the task of monitoring and control of these processes often find it difficult to effectively monitor the process data and take appropriate action to control the process. This project aims to develop artificial intelligence (AI) based solutions by integrating multi-physics simulation and system data to enable process monitoring with the target of obtaining Closed Loop In-Process Quality Control for remote laser welding. The multi-physics simulation is a high fidelity condition monitoring tool that can provide accurate process information. However, multi-physics simulation is a time-consuming process, and thus cannot be used for direct in-process control. On the other hand, artificial intelligence (AI) techniques can provide high precision only when process data of sufficient quality and quantity can be collected. This is not possible for the welding process using existing sensor technologies.</p>	
<p>Aims and Objectives: The aim of the project is to develop a soft-sensing platform, which integrates multi-physics simulations and AI techniques, to extract in-process estimates of multiple key parameters of remote laser welding. The objectives of the project are as follows:</p> <ul style="list-style-type: none"> • To do a literature review on in-process condition monitoring and in-process quality control for remote laser welding, • To identify key process parameters of remote laser welding, • To develop a multi-physics simulation of remote laser welding, • To develop AI techniques to integrate multi-physics simulation and system data to provide multiple key process parameters real time, • To test and validate the developed algorithms on a real remote laser welding cell, • To publish research outcomes in appropriate journals of international standing and to publish and disseminate the result of research and scholarship in other reputable outlets. 	
<p>Key skills required for the post:</p> <ul style="list-style-type: none"> - A 1st class undergraduate degree in Engineering (Electrical and Electronics, Mechanical/Aerospace, Manufacturing, Computer Science/Software Engineering, or other relevant subjects). - Analysis and problem solving. - Project management and organization. - Good knowledge or experience of AI/machine learning and/or multi-physics simulation software is desirable but not essential. 	
<p>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.</p>	
Lead supervisor:	Dr. Mien Van, School of Electronics, Electrical Engineering and Computer Science, email: m.van@qub.ac.uk
Other supervisor(s):	Prof. Adrian Murphy, School of Mechanical and Aerospace Engineering, email: a.murphy@qub.ac.uk Prof. Seán McLoone, School of Electronics, Electrical Engineering and Computer Science, email: s.mcloone@qub.ac.uk
Guaranteed stipend:	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.
Conditional top-up available:	A top up may be available for an exceptional candidate, dependant on the recommendation of the interview panel and industrial sponsor.
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.	

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.