QUB - Mechanical and Aerospace Engineering PhD Project 2019-2020

Title: Digital and Inter-Connected Manufacturing – Developing the next generation of digitised and inter-connected manufacturing facilities

Background and Technical Challenges:
Although the digitization of manufacturing related functions has been going on for decades within companies of manufacturing supply chains and international value networks, the availability of these technologies does not necessarily mean that factories and supply chains can today operate in an agile, seamless, transparent and productive manner. The development and industrial adoption of Industry 4.0 (I4.0) methods can improve the inter-connectivity of production assets and facilities, making extensive use of automation and a much wider use of big data, data analytics and machine-to-machine communication technologies. This opens up considerable opportunities for the development of the next generation of 'digitised and inter-connected manufacturing'.

The remaining technological challenges faced by manufacturing industry include; (i) understanding and enhancing the capability and capacity of distributed production networks to rapidly generate manufacturing processes and facilities for new and innovative products that are robust in terms of quality, cost effective, and agile, (ii) evaluating the capacity of distributed factories to scale up volume of production in response to changes in demand and (iii) utilising Cloud and IoT technologies that make possible an integrated way of monitoring and controlling production assets and products across multiple sites.

The research hypothesis is that these technological challenges can be addressed by developing and testing a novel, cyber-physical modelling framework for inter-connected facilities that will advance knowledge beyond the current state of the art in I4.0 manufacturing and also in agile and reconfigurable manufacturing.

Project Description:
The overall aim of the project will be to investigate the development of a novel and coherent 'Digital and Inter-Connected Manufacturing' framework that makes use of advanced cyber-physical systems modelling for establishing the inter-relationships between products, processes and facilities and then overlaying this onto the representation of capacity readiness within a production network.

The research will develop a new generation of cyber-physical models of distributed manufacturing facilities by researching the creation of digital models of process capability and production capacity that will be enhanced and refined by rapidly capturing and using real data generated from the processes and factories using distributed sensors and Cloud and data analytics technologies. This will allow the creation of a dynamic modelling environment where new processes and facilities can be modelled and deployed for new and innovative products and then real capability and capacity data would be collected from limited scale trial runs and initial production. The processing of real data using data analytics will refine the modelling predictions, thus generating seamless and high productivity manufacturing in inter-connected facilities.

The research will develop a technology demonstrator framework that will allow the testing of the methods developed and the evaluation of how the overall approach satisfies the research hypothesis that it can address the identified challenges, by using data from collaborating companies. The key findings of the research will be disseminated by writing papers for learned journals and presenting the research outcomes at academic conferences.

Key qualifications required for the post:
Applicants must have a strong 1st class honours degree in mechanical or aerospace engineering, or an equivalent qualification at Masters level. Candidates should be able to demonstrate that they are highly motivated, have excellent communication skills, and be able to undertake challenging tasks under their own initiative. Any experience relevant to process and factory modelling and data analytics would be advantageous, but is not essential.

This 3.5 year studentship is funded by EPSRC and is open to students who have been resident in the UK (ref. EPSRC eligibility requirements).

Key transferable skills that will be developed during the PhD:
The PhD student will develop advanced technical skills in I4.0 core technologies of cyber-physical modelling and the use of data analytics. In particular, the project will use advanced, state of the art process and factory modelling and simulation systems (such as the Dassault Systemes Delmia and Quest) for creating models of process capability and facility capacity. The physical modelling and testing aspects will involve using process-based networks of sensors and data analytics packages for processing the data generated.

Professional skills will be developed, including leadership, time management, project management as well as technical writing and presentation skills. This skill set is not limited to the manufacturing application context and will be readily transferrable into other technologies and sectors.

The project will involve extensive external collaborations with major digital manufacturing vendors like Siemens and Renishaw and also with manufacturing companies that participate in Industry 4.0 collaborative projects of the School. The PhD student will benefit from the strong collaborative links that Prof Maropoulos has within CIRP (The International Academy for Manufacturing Engineering) as a Fellow of CIRP as well as the collaborative relationships that exist with the Manufacturing Technology Centre at Ansty, Coventry and with major research groups at the Nanjing University of Aeronautics and Astonautics, China.

The PhD student will be encouraged to participate in the international technical community by attending selected high quality International Conferences such as the Winter Meetings and the General Assembly of CIRP, the Digital Enterprise Technology International Conference and the International Conference of Manufacturing Research. These events will provide a platform to develop a network of professional contacts for further career progression.

Lead supervisor:	Professor Paul Maropoulos MSc, PhD, CEng, FIMechE, FCIRP Professor of Advanced Manufacturing (paul.maropoulos@qub.ac.uk)
Other supervisor(s):	
Guaranteed stipend:	£15,009 per year
Conditional top-up available:	

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.