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

School of Electronics, Electrical Engineering and Computer Science

PhD Studentship 2020/21

Proposed Project Title: Resource allocation and control co-design in the cloud using the IIoT

Principal Supervisor:
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Research Area

Control and Systems Theory, IoT, Edge Computing, Resource Allocation

Proposal open to other School (indicate area of Interest)

EEECS, Mathematics

Degree linked to ELE

Degree linked to CSC

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.

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.

Project Description:

The potential offered by the abundance of sensors, actuators and communications in IIoT and Manufacturing is hindered by the limited computational capacity of local nodes, making the distribution of computing in time and space a necessity. Several key challenges need to be addressed in order to optimally and jointly exploit the network, computing, and storage resources, guaranteeing at the same time feasibility for time-critical and mission-critical tasks. The proposed research takes upon these challenges by dynamically distributing resources when the demand is rapidly time varying. Specifically, the overall aim is to propose a new resource allocation mechanism that take into account numerous issues appearing in Manufacturing such as time-criticality of applications, physical constraints, sharing of computation and communication resources etc. Although researchers from Computer and Network Science, Control Engineering and Applied Mathematics have proposed various approaches to tackle the above challenges, the proposed research will follow a holistic, multidisciplinary approach that combines and extends recent, albeit fragmented results from all aforementioned fields, with the ultimate goal to bridge the gap between efforts of different communities.

Objectives

-**Propose and establish an analytic mathematical dynamical modelling of the resources, offered workload, and networking environment, that incorporates phenomena met in wireless communications, mobile edge computing data centres, and network topologies in Manufacturing. We also propose a new set of estimators for the workload and resources time-varying profiles that continuously update the model parameters.**

- Building on this framework, develop novel resource allocation mechanisms that take explicitly into account service differentiation and context-awareness, and most importantly, provide formal guarantees for well-defined QoS metrics in Industry 4.0 applications.

- Propose new control algorithms for industrial cyber-physical systems (CPS), by incorporating resource allocation mechanisms to the decision strategy itself, by building a new generation of controllers, driven by a co-design philosophy both in the network and computing resources utilization.
-Test developed algorithms in testbeds (edge computing cluster and Indutry 4.0 application) offered by EEECS and NITC (Northern Ireland Technology Centre).

Academic Requirements:

A minimum 2.1 honours degree or equivalent in Engineering, Computer Science, Applied Mathematics, or relevant degree is required.

GENERAL INFORMATION
This 3.5 year PhD studentship, potentially funded by the Department for Employment and Learning (DfE), commences on 1 October 2020.

Eligibility for both fees and maintenance (approximately £15,000) depends on the applicants being either an ordinary UK resident or those EU residents who have lived permanently in the UK for the 3 years immediately preceding the start of the studentship. Non UK residents who hold EU residency may also apply but if successful may receive fees only.

Applicants should apply electronically through the Queen's online application portal at: https://dap.qub.ac.uk/portal/

Further information available at: https://www.qub.ac.uk/schools/eeecs/Research/PhDStudy/

Closing date for applications: 15 March 2020