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: DTP: Condition-based maintenance using hidden semi-Markov models

Principal Supervisor: H Mitchell

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Research Area
Statistics/Data analytics

Proposal open to other School (indicate area of Interest)
Mathematics and Physics

Degree linked to ELE (delete as appropriate)

Degree linked to CSC (delete as appropriate)

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:

Monitoring machines for the purpose of diagnostics and prognostics commonly referred to as condition-based maintenance (CBM) has the potential to improve efficiency and reduce costs. Diagnostics are used to determine the current health status of a machine/ component whereas prognostics predicts the remaining useful life of the machine/component. By obtaining what the current health state of a machine is and then predicting when it will fail should not only save the company money but will also improve efficiency [1].

The hidden Markov model (HMM) has been used to describe the health states during a components degradation. These models are referred to as a doubly embedded stochastic process as they can be characterised as consisting of a stochastic process which is unobservable and can be inferred from another observable stochastic process. They have a rich mathematical structure however they can be restrictive in terms of the Markov assumption. The Markov property within the HMM can be seen as a possible disadvantage when using the HMM to model real-world situations as it assumes that the time spent within the hidden layer of the HMM follows a geometric distribution. The hidden semi-Markov model (HSMM) relaxes this assumption by allowing a variable duration or sojourn time for each of the hidden states [2]. This project will develop the hidden semi-Markov model further in order to increase the accuracy of predicting the remaining useful life and current state of the component.

Objectives:

This project proposes the investigation and development of HSMM's within the application area of CBM taking into account non-constant machine use with the aim to increase the accuracy of predicting the remaining useful life and current health state of the component.

Academic Requirements:

A minimum 2.1 honours degree or equivalent in Computer Science or Electrical and Electronic Engineering 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