

## QUB - Mechanical and Aerospace Engineering PhD Project 2019-2020

**Title: Computer aided process planning for multi-tasking machines and multi-machine tasks**

**Project description:**

One of the key challenges for the UK to emerge as a global leader in manufacturing and automation is enhanced productivity. Productivity enhancement can be achieved in many ways, one of which is to perform multiple tasks at the same time. Examples of this are double-sided milling, pinch turning and double sided incremental forming. Another way of enhancing productivity is to carry out tasks using multiple machines operating in parallel. Examples of this include multi-robot teams that fabricate different parts of an aerospace structure simultaneously using 3D printing, use of unmanned aerial vehicles together with unmanned ground vehicles in routing parts around a shop floor and carrying out preventative maintenance.

Both multi-tasking machines and multi-machine tasks are an active area of research with a lot of future potential in transforming the UK industry. At this time, setups are available at Queen's to enable this research in the form of parallel kinematic machines, collaborative robots with multiple arms, omni-directional platforms and drones. There is active interest in this line of research with a number of partner firms that have been enlisted recently, which include firms from aerospace, semi-conductor fabrication and construction sectors.

This project will involve the development of computer aided process planning tools for multi-tasking machines and multi-machine tasks with a view to optimizing processes associated with these machines and tasks. This will require design, fabrication and integration of mechanical hardware with associated electrical and electronics and interfacing it with the developed process planning tools. Processes will be optimized keeping key technological outcomes in mind such as residual stresses, surface finish, accuracy and machining time. The process planning tools will incorporate algorithms for feature analysis and detection, computer vision and toolpath planning that are linked to the key technological outcomes.

**Aims and Objectives:**

The aim of this project is to develop the first generation of computer aided process planning tools for multi-tasking machine and multi-machine tasks that enable optimization of key technological outcomes associated with processes run on such machines. The objectives of this project are:

- To establish the requirements for optimization of processes associated with multi-tasking machine and multi-machine tasks
- To design and fabricate requisite hardware for the operation of these machines
- To carry out mechatronics system integration that enables the mechanical hardware to carry out defined tasks associated with specific processes such as double-sided machining or simultaneous 3D printing
- To design and develop software prototypes that enable process planning for these machines
- To optimize selected manufacturing process(es) using the developed process planning software tools
- To test and validate the process planning tools for selected technological outcome(s)

**Key skills required for the post:** Mechanical design, Programming (preferably Visual C# and Python)

**Key transferable skills that will be developed during the PhD:** Systems integration, project management

**Lead supervisor:** [Dr Amar Kumar Behera, a.behera@qub.ac.uk](mailto:a.behera@qub.ac.uk), +44 28 9097 4769

**Other supervisor(s):** [Prof Adrian Murphy](#), [Dr Yan Jin](#), [Dr Trevor Robinson](#)

**Guaranteed stipend:** £14,925

**Conditional top-up available:** A performance dependent top up based on recommendation of interview panel of upto £3000/year is available alongwith the opportunity to be seconded in EU project partner institutions, where the cost of travel and living expenses will be fully subsidized (up to 2000 Euros/month)

**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.*