



School of Computing, Engineering, and the Built Environment Edinburgh Napier University

PHD STUDENT PROJECT

Funding and application details

Funding status: Self funded students only

Application instructions:

Detailed instructions are available at <https://blogs.napier.ac.uk/scebe-research/available-phd-student-projects/>

Prospective candidates are encouraged to contact the Director of Studies (see details below) to discuss the project and their suitability for it.

Project details

Supervisory Team:

- DIRECTOR OF STUDY: Gokula Vasantha (Email: G.Vasantha@napier.ac.uk)
- 2ND SUPERVISOR: Alistair Lawson

Subject Group: Engineering & mathematics

Research Areas: Integrated Engineering, Manufacturing Engineering, Mechanical Engineering, Artificial Intelligence, Data Science, Machine Learning, Electrical Engineering, Electronic Engineering

Project Title: Design and Simulation of Adaptive Product-Service System for Distributed Manufacturing

Project description:

Product-service systems (PSS) aim to deliver value-in-use through integrated product and service solutions. Underpinned by sustainability research, PSS intend to produce a balanced approach to production and consumption. This PhD research project aims to combine two critical themes in sustainability: Product-Service Systems (PSS) and Distributed Additive Manufacturing. Developing PSS for distributed additive manufacturing needs to consider from overall system-centric perspectives with the involvement of multiple collaborative agents and their

requirements (e.g. manufacturers, consumables suppliers, end-users, designers etc.), 3D printers capabilities and efficiencies, design CAD models, and process streamlining for distributed manufacturing with consumables availability.

This research considers the development of a simulation-based approach for designing product-service systems for distributed additive manufacturing, systematically incorporating above mentioned multi-facet elements. The simulation aims to create a novel approach for PSS representation, in-situ monitoring, and performance assessment. The specific objectives of this project are (i) agent-based simulation behaviour modelling to study multiple scenarios of PSS types, (ii) develop a system for in-situ performance monitoring for multiple 3D printers, and (iii) integrate real-time performance data in the simulation model to assess the possible adaptations required in the system to deliver the proposed PSS model.

This research requires an excellent understanding of manufacturing systems (mainly 3D printing), system engineering principles, data analytics, and machine learning (i.e., predictive modelling) techniques. Furthermore, the research involves a complete data processing cycle, such data collection with appropriate sensors, data integration, data cleaning and data transformation. Therefore, it would be ideal if the PhD candidate has experience in data analytics or system simulation modelling software such as SimUI8 and programming skills.

The research will be based at the Flexible Manufacturing Laboratory at Edinburgh Napier University and will include collaboration with colleagues from the Computer Science Group who already work with us on intelligent manufacturing systems research, with expertise in the areas of AI, Machine Learning, and Software and Systems Development. The researcher joining this project will develop and train in the appropriate technical areas. In addition, the researcher will be encouraged to present the work at leading international conferences and workshops. The researcher should have an appetite for undertaking an enquiring and rigorous approach to research together with a keen intellect and disciplined work habits.

References:

- [1] Vasantha, G. V. A., Roy, R., & Corney, J. R. (2015). Advances in designing product-service systems. *Journal of the Indian Institute of Science*, 95(4), 429-448.
- [2] Vasantha, G. V. A., Komoto, H., Hussain, R., Roy, R., Tomiyama, T., Evans, S., Tiwari, A. & Williams, S. (2013). A manufacturing framework for capability-based product-service systems design. *Journal of remanufacturing*, 3, 1-32.
- [3] Hussain, R., Lockett, H., & Vasantha, G. V. A. (2012). A framework to inform PSS Conceptual Design by using system-in-use data. *Computers in Industry*, 63(4), 319-327.

Candidate characteristics

Education:

A first-class honours degree, or a distinction at master level, or equivalent achievements in Mechanical or Production and Manufacturing or Data Science or Operation Research or Electrical and Electronic Engineering with a good fundamental knowledge of data analytics and manufacturing systems and performance

Subject knowledge:

- Experience of fundamental intelligent manufacturing systems and processes

- Competent in data analytics and statistical techniques
- Knowledge of simulation processes and prediction approaches

Essential attributes:

- Good written and oral communication skills
- Strong motivation, with evidence of independent research skills relevant to the project
- Good time management

Desirable attributes: