

**Topic: In-process sensing and machine learning for surface measurement**  
**Location: The University of Nottingham**

In this project, the student will develop the sensing technologies to realise the next generation of digital manufacturing: Industry 4.0. An essential part of manufacturing is quality control, which is achieved through measurement. One of the most important measurands for quality control is the surface – In discrete manufacturing fine-scale topography is critical when considering tolerances, assembly and ultimately functionality whereas in process manufacturing the surface affects the quality and performance of products (e.g food and other FMCG). It is estimated that surface effects cause 10% of manufactured parts to fail and contribute significantly to UK GDP. Mostly in manufacturing, measurements are taken after manufacture or by slowing down the process – compromising the all-important throughput. The student will combine different sensor techniques with state of the art machine learning methods such as deep learning and transfer learning to produce enhanced measurement systems that are an integral, real-time and constantly learning part of the manufacturing process – not only fast enough but becoming faster over time. The project will be focused on the sensor development and testing, but the balance of modelling and experimental methods can be chosen to suit the background of the student.

The project will be supervised by Dr Nicholas Watson and Professor Richard Leach, from the Manufacturing Metrology Team (MMT). MMT is an international and diverse team that thrives on openness and cooperation – students work in teams to achieve joint goals in a friendly but professional cohort.

The position is available for UK candidates, but EU or International applicants who can pay the difference between the Home and International Fees would also be welcome to apply. Candidates must possess or expect to obtain, a high 2:1 or 1<sup>st</sup> class degree in science, engineering or computer science, or other relevant discipline.

### **Supervisor: Dr Nicholas Watson**



Nik is an active member of the UK's Digital Manufacturing research community and currently a Co-Investigator on the EPSRC's Digital Manufacturing Network: Connected Everything. Nik regularly speaks at Industry events on the topic of Digital Manufacturing, Industry 4.0 and Artificial Intelligence within the food and drink sector with invited international talks including: The Food and Drug Administration's Applications of Artificial Intelligence in Food and Cosmetics Safety Colloquium (2020) and the Australian Institute of Food Science and Technology Virtual Convention (2020). Nik has extensive industry collaborative experience with manufacturers in the food and drink, pharmaceutical and FMCG sectors ranging from micro SMEs to multinationals in addition to technology providers and integrators. Nik is currently a member on the EPSRC's Early Career Forum in Manufacturing Research and on the Food Standards Agency's Register of Experts.



### **Supervisor: Professor Richard Leach**

Richard is currently a Professor in Metrology at the University of Nottingham, Director of the Midlands Centre for Data-Driven Metrology, Head of the Manufacturing Metrology Team and prior to this spent 25 years at the National Physical Laboratory. He has been researching and lecturing on surface metrology for over 30 years. He is on the Council of the European Society of Precision Engineering and Nanotechnology, the Board of the American Society of Precision Engineering and several international standards committees. He is the European Editor-in-Chief for Precision Engineering and has over 500 publications including eight textbooks. He is a Fellow of the International Academy of Production Engineering (CIRP), the Institute of Physics, the Institution of Engineering & Technology, the Higher Education Authority, the Institute of Measurement & Control, and the International Society of Nanomanufacturing. He is a visiting professor at Loughborough University and the Harbin Institute of Technology.