**EPSRC supported EngD**: Development of Reduced Order Zonal Models with Data-Driven Approaches for Complex Fluid Mixing in Stirred Tanks

Prof Mark Simmons ( Chem Eng, U of Birmingham )

Johnson Matthey

**Tax free bursary of £ 20,900 p.a. plus fees paid**

The key objective of the project is to develop a data analytics-driven methodology to derive simplified mixing models that contain spatially resolved detail but that are sufficiently low on computational demands that they can be run in real time as “digital twins” for enhanced design and control; towards *industrie4.0* approaches to complex mixing.

Johnson Matthey [JM] is a UK-based FTSE 100 listed company that is a leader in sustainability and sustainable technologies. A leading position in a number of associated technologies such as fuel cells, battery materials, environmental catalysts, raw materials recycling and hydrogen technology is accompanied by net zero aspirations for our own operations.

JM has a number of fluid mixing processes that involves complex mechanisms. These are critical steps in the manufacture of wide range of products. While JM has well established expertise, experimental methods and Computational Fluid Dynamics (CFD) modelling, it is difficult to exploit these optimally in the scale up of new products and processes. The proposition is therefore to develop a capability in reduced order, or zonal continuity models, that are simple and computationally small enough to be used more readily than CFD in projects and for model based control of manufacture.This concept of representing a stirred tank by a limited number of interconnected zones has been previously demonstrated in JM for analysis of complex mechanisms in non-Newtonian mixing and precipitation. However, all of the previous studies used many empirical correlations and assumptions and limited data sets for their calibration.

The objective of this project is to apply advanced data analytical approaches, including Machine Leaning (ML), to extract data and information from CFD simulation results as well as from advanced experimental flow visualisation techniques available in JM and at the University. These analyses and ML models will be combined with key physical and scaling relationships to provide a predictive but largely data driven tool for the scale up and optimisation of mixing processes. This is an important step in the progress towards the digitisation of our manufacturing processes.

To be eligible for EPSRC funding candidates must have at least a 2(1) in an Engineering or Scientific discipline or a 2(2) plus MSc and be a UK national. Please email your c.v. to r.w.greenwood@bham.ac.uk. For details on the Engineering Doctorate scheme visit the [homepage](http://www.birmingham.ac.uk/schools/chemical-engineering/postgraduate/eng-d/index.aspx). Deadline 5 th July 2021