**EPSRC supported Engineering Doctorate. Prediction of complex industrial flows in the transitional regime.**

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**Tax free bursary £19,900 p.a plus fees paid**

Whilst the simulation of flow in industrial reactors is now relatively well mastered for a wide range of chemical and process engineering applications, there are still several areas that require research effort, including the simulation of multiphase flows, flows with complex rheology and microstructure, and transitional flows (i.e. that are neither purely laminar nor fully turbulent). For the two former examples, there is a need for the development of physical models (e.g. drag laws, rheological models) that correctly describe the local flow behaviour. For the latter however, there is not only a very poor understanding of the causes of the transition from laminar to turbulent flow, but also a complete lack of simulation methodology for describing such flows.

Transitional flows are encountered readily in industry in diverse fields of formulation engineering (e.g. foods, personal care, pharmaceuticals, paints, lubricants) due to the nature (e.g. high viscosity, non-Newtonian rheology, complex microstructure) of the products being manipulated, as well as the intricate designs of the process equipment being used. The simulation of transitional flows in reactors is therefore very challenging because hydrodynamic instabilities create unsteady flow, which needs to be correctly captured. Turbulence models are typically not well adapted at transitional flow Reynolds numbers because the eddy viscosity hypothesis used in the models is currently designed for high Reynolds number turbulence. Ultimately, the full resolution of the time-dependent Navier-Stokes equations on an extremely fine 3-dimensional mesh would be desirable, however such simulations require excessive computing efforts, which are not viable for practical engineering applications.

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