Exploring micro and nanoflows: modelling and simulation

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Fluid flows at the micro and nano-scale are characterised by non-equilibrium and non-continuum effects that place them beyond the modelling scope of conventional Computational Fluid Dynamics (CFD). Typically, a molecular or particle treatment of the liquid or gas, and any bounding surface, is required to accurately resolve such flows. However, the cost of these particle-based simulations is prohibitively costly for all but the simplest geometries. In this talk a number of computational approaches are introduced and used to investigate the fundamental behaviour of micro/nano flows: the 'hybrid' approach, which combines the efficiency of CFD with the accuracy of particle simulation [1-2]; extended hydrodynamics, whereby continuum equations are solved that reach beyond the scale limitations of the Navier-Stokes model [3-4]; and fluctuating hydrodynamics, where thermal noise is incorporated into continuum models to capture important nanoscale interfacial phenomena [5-6]. The talk describes research funded in the UK by the EPSRC (EP/V01207X/1; EP/N016602/1; EP/K038664/1).

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