"Direct numerical simulation of fluid-particle systems"

Abstract:
The interaction between turbulent flow and solid particles is of relevance in a considerable number of technical applications (e.g. civil and chemical engineering, combustion) as well as natural processes (meteorology, blood flow, ...). Reliable flow data is, however, still scarce due in part to measurement difficulties in these multi-phase flow systems.

Traditionally, suspensions involving large numbers of particles have been described computationally (at best) by a point-particle approximation. However, when the size of the particles is comparable to or larger than the smallest flow scales, this ansatz loses its validity. The same is true when the Reynolds number of the flow around individual particles is not negligibly small. We are performing numerical simulations for finite particle sizes, where the computational particles are larger than the grid and their interface is resolved. For this purpose we resort to an immersed-boundary technique which allows for an efficient representation of submerged solid bodies in arbitrary motion across a fixed computational mesh.

In this talk the need for rigorous validation and benchmarking will be stressed, and computational requirements for high-fidelity simulations are discussed. Results for simulations of particle settling in unbounded and wall-bounded fluid with and without background turbulence will be presented.