Opportunities

Funded Ph.D. positions

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General

Alexander-von-Humboldt Foundation

The Alexander-von-Humboldt Foundation can provide funding to foreign scientists wanting to work in Germany, see › www.humboldt-foundation.de (http://www.humboldt-foundation.de)
if you are interested to collaborate with us, please have a look at available opportunities and contact us.

DAAD

DAAD (Deutscher Akademischer Austauschdienst) can provide funding to foreign PhD students wanting to perform (part of) the Ph.D. studies in Germany, see › www.daad.de (http://www.daad.de)
If you are interested to collaborate with us, please have a look at available opportunities and contact us.

B.Sc. and M.Sc. theses

If you are a motivated student, and want to write your Master or Bachelor thesis on one of the following topics, please contact us:

- **Simulations of Sandpiles: Studying the angle of repose and pressure distribution under adhesive, prismatic sandpiles.** Sandpiles are formed due to the dissipative forces between particles, and the dissipative mechanisms are strongly linked to macroscopic properties of a sandpile. Although many sandpiles may look the same, their macroscopic features differ greatly, especially the angle of repose and the pressure distribution under the sandpile. In this project you will use our in-house Discrete Element Model (DEM) software to study the formation of sandpiles. The goal is to investigate the behaviour of the angle of repose and pressure distribution under prismatic sandpiles when varying the particle properties and sandpile formation process.

- **Simulating particle behaviour in rotating drums.** Rotating drums are widely used in industry to mix particles, to grind particles, to bake particles, to dry particles, and so on. Rotating drums ability to handle varying feed materials, in particular granular materials with broad particle size distribution, shape and significant difference in physical properties. However, the scale-up methodology for such devices is still largely empirical and no general and systematic method has been established. This project aims to numerically study the behaviour in rotating drums, using our in-house software code, tracking the motion of each particle. Different types of phenomena and flow regimes can occur in a drum, such as avalanching, segregation, mixing, drying, aggregation, comminution (abrasion, attrition and fracture) and convection. These phenomena and occurrence of flow regimes strongly depends on the particle properties (size, shape, weight), the drum geometry, and the speed of the rotating drum. In this project, the aim is to study the different regimes in rotating drums, the mixing in drums, and the particle stresses occurring in rotating drums as a function of the mentioned parameters.

- **Modelling of Fluidized Bed Processes.** Fluidized bed reactors are one of the most common types of reactors used in in a wide variety of industries, e.g. chemical-, pharmaceutical-, mining-, food-industries, and many others. Fluidized bed reactors also have a wide range of applications, e.g. reaction-, coating-, drying- and heat-exchanging processes. This type of reactors is widely used because of two main advantages: its excellent mass and heat transfer properties. Although fluidized beds are frequently used, little more than empirical and phenomenological models are available to predict their behaviour, making the design and scale-up of such reactors more art than science. Because of the extensive use of fluidized beds, improvements in reactor design may lead to large improvements through increased production capacity and/or process selectivity, as well as loss cuts through, for example, decreased recycle rates. The goal of this project is the modelling of gas-solid fluidized beds, by performing detailed simulations with a computational fluid dynamics (CFD) code. The effect of particle size, particle size distribution, fluid inlet velocity will be determined and compared to experiments and literature findings. Also, simulations of a fluidized bed combuster, with combusting bio-mass or coal particles will be modelled.

Detailed Study of the Interaction of Turbulent Flow with Particles. Turbulent gassolid flows are found in many industrial applications such as cyclone separators, jet mills, fluidized beds, inhalers, nuclear reactor cooling systems, pneumatic transport of powders and pulverized-coal combustors. They also occur in nature, e.g., desert sand storms, pollen in air and dispersion of pollutants. For a reliable understanding of turbulent gassolid flow phenomena, adequate models are needed. Such modeling will improve the design and optimization of processes dealing with this flow type. To successfully simulate a gassolid flow system, it is necessary to account for particleparticle collisions as well as gasparticle interactions, mainly the effect of the gas- phase turbulence on the particle motion and vice versa. Furthermore, the momentum and energy transfer due to particle collisions needs to be properly formulated. In this project, a detailed study of the turbulent flow and individual particles will be performed with a Lagrangian particle model. Lagrangian, or discrete particle models, trace the path of individual particles on their way through the flow field by integrating the equation of motion, that is, Newton's second law. Additionally, forces from the turbulent gas-phase acting on each particle are taken into account. In this project, the detailed simulations will be compared with experimental findings of turbulent gas-solid flows and jets, leading to validation and model development and improvement.

The Richtmyer-Meshkov instability in compressible two-phase flows. The Richtmyer–Meshkov instability occurs when two fluids of different density are suddenly accelerated by the passage of a shock wave. The RM instability has important applications, e.g. in inertial confinement fusion and supersonic combustion, and can serve as a canonical reference system to understand the interaction of shock waves with fluid interfaces, e.g. during cavitation or supersonic droplet breakup. In this project, you will be using our in-house CFD code for interfacial flows in all Mach-number regimes to conduct a numerical study of the RM instability in gas-gas, liquid-liquid and gas-liquid flows. After an introduction into our simulation tools, you will study the growth and evolution of the RM instability for different fluid combinations and assess the influence of the applied numerical schemes as well as the influence of viscous stresses, thermal conduction and surface tension on the evolution of the RM instability, in comparison to linear stability analysis and experimental measurements found in the literature.

Capillary jet breakup. The breakup of a liquid jet due to surface tension, the Rayleigh-Plateau instability, is a phenomenon of industrial importance as well as great visual beauty. Because of its relevance for many engineering and technological applications, such as inkjet printing of binders in 3D-printing or of complex material coatings, it is a very active research topic. Computational fluid dynamics (CFD) has thereby been found to be a valuable tool for studying these complex flows, in addition to classical experiments and mathematical analysis. Yet, despite extensive research efforts since Lord Rayleigh formulated the first consistent mathematical theory of this type of flow in 1879, there are still many aspects of capillary jet breakup that we do not fully understand. Two unresolved questions of particular interest, which can be the basis of an ambitious BSc/MSc project, are (i) how large excitation amplitudes influence the breakup behaviour of the jet, which is has direct implications for engineering applications, such as 3D-printing, and (ii) how does the breakup evolve on a curved liquid filament, the understanding of which is important for an accurate modelling of atomisation processes, such as fuel injection.

Chair:

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