Modélisation et Simulation Multi Echelle MSME UMR 8208

Intern position: Development of a non-spherical particle collision model for Particle-Resolved Direct Numerical Simulations.
Duration: 6 months full-time position starting ideally 1st March 2020.
Net salary: 900€/month.
Location: Université Paris-Est Marne-la-Vallée, Laboratoire MSME (http://msme.u-pem.fr/).
Supervisors: Mohamed-Amine Chadil, Stéphane Vincent.
Key words: Numerical methods, Fluid mechanics, Mechanics, Programming.

Particle laden flows are widely encountered in nature (Volcanic eruptions, pollution …) and in many industrial processes (CO2 capture in power plants with fluidized bed technology, …). The numerical study of such applications requires statistical description of the flow due to the scale disparity between that of the application (macro-scale) and the particles one (micro-scale). Thus, at the macro-scale, Navier-Stokes equations contains many closure terms (some for the turbulence and others to take into account the presence of the particles). All these terms need to be modeled.

The exponential increase of the computation power makes the numerical simulations at the smallest scale the best way to develop these models. Indeed, Particle-Resolved Direct Numerical Simulations (PR-DNS) are providing data describing all the phenomena taking place at the micro-scale, and that with wide range of values for the parameters characterizing the flow. Therefore, models for the drag coefficient, Nusselt number among much more others are extracted from these data to be used at the macro-scale.

Spherical particles are rarely encountered in both natural and industrial processes, and particle non-sphericity can affect not only the structure of the particle aggregates but also the velocity and the temperature of the fluid by changing the momentum and heat transfer between the fluid and the particles. Hence the need to integrate non-spherical features in the home-made multi-scale code RESPECT, used to perform the PR-DNSs in order to provide suited sub-grid models for non-spherical particles laden flows.

The aim of this internship is to develop a robust method to first detect collisions between non-spherical particles and to compute the volumetric force distribution over the particles that accounts for the reel collision. Once this method is implemented in RESPECT, PR-DNS of fluidized bed with non-spherical particles will be performed to assess the particles non-sphericity effect on the statistical parameters (granular temperature, kinetic energy, …).

The intern will have the opportunity to strengthen his/her knowledge on numerical methods, fluid mechanics, programming, and to discover a very challenging field in academic research. Moreover, he/she will have access to a very powerful tool (RESPECT) to perform PR-DNS which is a formative and rewarding experience.

Qualifications: to be a 5th year student in applied mathematics or numerical fluid mechanics at an engineering school or university. To be motivated and hard-working person with good communication skills, especially written English. FORTRAN and MPI programming skills are also required.

Application: candidates are invited to send their CV and a motivation letter to mohamed-amine.chadil@u-pem.fr