Post-Doctoral Position
« Rheology and particle migration in suspensions of hard to soft particles »

Project summary

The project aims at studying numerically the rheological properties of suspensions of hard to soft spheres, dispersed in a Newtonian fluid, which are found in many industrial and geophysical processes. Using a DEM approach, and a recently developed model of lubricated contact, we will study the role of particle deformability, an essential ingredient which is usually overlooked in existing simulations. Deformability is crucial to regularize the divergence of the lubrication forces at contact, but its effects on the suspension rheology remain to be investigated in depth.

Our recently developed model of lubricated contacts [Chevremont et al., Powder Tech. 2020] produced new results related to the role of contact friction [Chevremont et al., Phys. Rev. Fluids 2019] and led to a complete set of constitutive relations for dense suspensions [Chevremont et al., arxiv.org/abs/2103.03718]. This model is implemented in the open source code yade-dem.org. We are now able to tackle efficiently the case of slightly deformable particles, for which lubrication, friction and deformability are strongly coupled.

At a macroscopic level, these effects are ignored by the established "μ(Iv)" constitutive model of hard sphere suspensions, as there is a new dimensionless number characterizing the ratio of viscous stresses to particle stiffness, the capillary number Ca. One goal of this project is to extend the μ(Iv) rheology to a phenomenological μ(Iv,Ca) rheology, which we will characterize by DEM simulations with systematic variations of the particle deformability, in a large range of volume fractions and shear rates.

We will also focus on viscous resuspension, which occurs when an external force field (typically gravity) is exerted on a flowing buoyant suspension, leading to gradients of volume fraction. This phenomenon is closely related to particle migration and the study of the transient regime from a homogeneous (non flowing) suspension to the re-suspended steady state will lead to improve existing continuum models by determining expansional viscosity.

This numerical project will be conducted in close relation to an ongoing experimental study.

Location and practical aspects

The successful applicant will be hosted at laboratory LRP. He/she will work under the supervision of Pr Hugues Bodiguel from Laboratory LRP, of Dr. Bruno Chareyre from Laboratory 3SR and of Dr. Romain Mari from laboratory LIPhy.

The gross salary will be 2656 euros/months, equivalent to a net salary of 2134 euros/month.

Qualifications of the applicant

Applicants should have a PhD in fluid mechanics, granular/soil mechanics or soft matter physics, with a good experience in numerical simulations. The DEM software uses python for scripting simulations. This project does not require important numerical developments. However, an ability to manage and analyze large amounts of data and an appeal for modeling is expected.

Applications

Interested candidates should send their CV and cover letter to hugues.bodiguel@univ-grenoble-alpes.fr

Deadline for the application: 15/06/2021

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