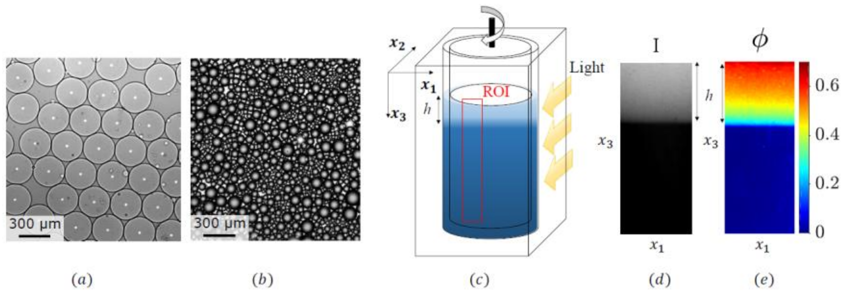
Post-doc position available in Grenoble

Migration and margination in suspensions of deformable non-Brownian particles

Suspensions made of solid particles dispersed in a liquid exhibit rheological properties which strongly depend on the volume fraction. In addition, the volume fraction field is generally non-uniform due to migration of particles from high to low shear regions of the flow. This shear-induced migration is a consequence of the particle normal stress. During the past decade, a consensus has progressively emerged in the literature concerning the crucial role of contact forces between particles, which become dominant at volume fraction above 40% (see e.g. *Chèvremont et al., Phys. Rev. Fluids 2019*). This project aims at considering another type of system, an emulsion, which has not been studied in terms of shear-induced migration (except in *Hollingworth et al., JCIS 2006*), despite its practical importance in various domains. As compared to suspensions of rigid particles, contact interactions between droplets are rather different, and one also expects a role the particle deformability, already evidenced in very dilute emulsions.

Recent work (Saint-Michel et al., Phys. Fluids 2019; D'ambrosio et al. 2020) have successfully determined the particle normal stress for solid particles using viscous resuspension, by taking advantage of the volume fraction field established in a Couette cell due to the balance with buoyancy in the vorticity direction. We are extending this approach to suspensions of droplets. Strikingly, preliminary results indicate that the particle normal stress is very similar to that of solid particles. Even more surprisingly, it remains in a first approximation unchanged when the emulsion is polydisperse. However, in this case, one can expect that the droplet size is no longer uniformly distributed, but that big particles are segregated from smaller ones, as in the margination phenomenon well known for granular materials.



a) Monodisperse emulsion produced in a microfluidic setup. b) polydisperse emulsion. c) transparent Couette cell.
d) Transmitted light intensity (the droplets are bright and lighter than the fluid). e) Volume fraction field

We are using light absorption by a dye dissolved in the disperse phase to determine the volume fraction. In this project, we will extend this approach in order to determine simultaneously thanks to an optical setup the local mean droplet size, allowing full description of the combined migration and margination phenomenon. The setup will be applied to both bi- and poly-disperse droplets.

A strong background in experimental fluid mechanics, soft matter or rheology is expected.

Applications should be sent by email to hugues.bodiguel@grenoble-inp.fr, including CV, motivation letter and references.

Post-doc duration: 1 year (with some extension possibilities)

Preferential starting date: before the 1st of April 2021.