CONFLUENCES IMFT

Institut de Mécanique des Fluides

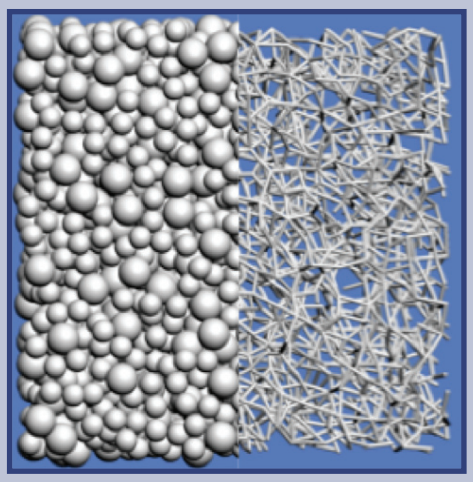
Amphithéâtre Nougaro (Entrée A) - 2 Allée du Pr Camille Soula, Toulouse

Mercredi 29 Mars - 10 h 00

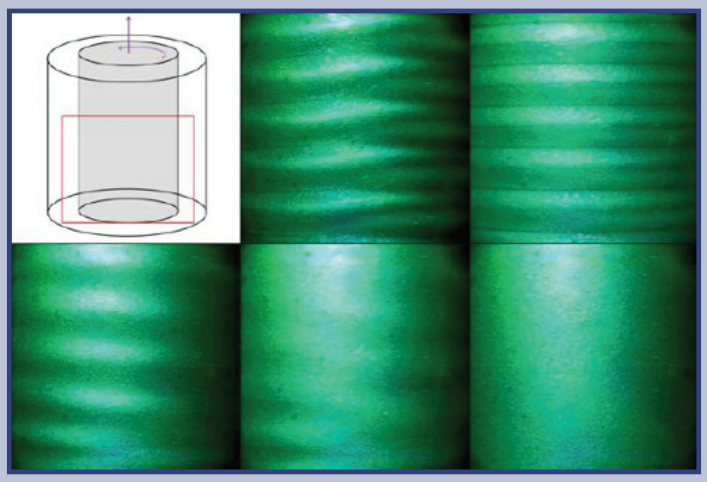
Jeff MORRIS

Levich Institute, CUNY City College of New York & FERMAT Foundation "NEMESIS" program

Suspension dynamics from classical fluids to jammed granular solids



Contact network: shear thickening suspension



Flow structures: suspension in Taylor-Couette flow

Suspensions, or dispersions of solids in liquids, display a wide range of behaviors, depending largely on the particle volume fraction ϕ. Here, we describe fluid mechanical behavior as well as nearly granular dynamics. We consider simple suspensions of spherical particles which have very short-range or contact forces in addition to hydrodynamic interactions. An overview of two investigations will be given, one an experimental study of the classical Taylor-Couette flow for suspensions of solid fraction up to $\phi = 0.3$, and the other a simulation study of extreme shear thickening and shear jamming in suspensions of $\phi > 0.55$.

The influence of particles density matched to the fluid on the inertial instabilities in Taylor-Couette flow is studied for the case of only the inner cylinder rotating (ICR). We find that the particles reduce the critical Reynolds number for onset of instability of the circular Couette flow, while resulting in flow structures not seen for a pure fluid in ICR conditions. Comments on the possible basis for this behavior in the suspension rheology and the finite size of the particles will be offered, but no clear explanation is yet known.

In very concentrated suspensions, our discrete-particle simulations show that a stabilizing repulsive force sets the stress scale for onset of shear thickening. When a frictional contact interaction is allowed, at sufficient solid loading (this level depends on the friction coefficient for contacting particle surfaces) the suspension undergoes a strong thickening. This thickening is evidence of a transition to a granular type of behavior and the thickening can be discontinuous shear thickening with a sudden jump in the viscosity if performed under controlled shear rate; under controlled shear stress, the suspension may display a decrease in shear rate with increasing stress, and eventually jam.

Service communication IMFT

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