Invitation to

Fluid Mechanics & Engineering

Colloquium

#02/SY2022

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A1-17 講義室　工学部Ａ棟１階

講　　師　Dr. Franco TAPIA（東京大学地震研究所・博士研究員）

講演題目　Local rheology of non-colloidal suspensions in a dense regime

講演内容：

The fundamental understanding of dense granular flows of non-colloidal particles suspended in a fluid matrix remains a challenge, even in the simplest case of spherical particles immersed in a Newtonian fluid. The collective character, spatial disorder, and out-of-equilibrium state make it difficult to establish a set of constitutive equations to describe them. However, important progress in experimental and numerical studies gives us some interesting clues about how particle-particle (roughness and shape) and fluid-particles interactions (interstitial fluid viscosity) could affect the macro-rheology of granular suspensions, in particular how the relative viscosity evolves as a function of the solid volume fraction close to the jamming transition.

The presence of solids particles in suspension increases the anisotropy of the system, leading to a non-zero stress difference. Inspired by granular mechanics, a frictional description presents as an interesting tool to complement classical rheology. Thus, the rheology is described by two dimensionless quantities: the effective friction coefficient (or stress anisotropy) and the global packing fraction. Since a simple dimensional analysis, these parameters are mainly ruled by the viscous number J in over-damped flows and by the inertial number I, once particle inertia takes place (Bagnold regime).

We present here a brief description of how the rheological properties of non-colloidal particles evolve as a function of their mechanical and geometrical features. Well-controlled experiments under pressure and volume imposed conditions are performed to describe how geometrical properties of solid particles modify the algebraical function in the neighborhood of the jamming transition. Additionally, by systematically varying the interstitial fluid viscosity, we show that the viscous to inertial transition takes place at a specific Stokes number, independent of the packing fraction. The algebraic power law for the viscosity divergency is also shown to follow a frictional behavior and be independent of the regime.

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