Modelling and simulation of dense particle systems with complex suspending media

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ABSTRACT

Particulate suspensions are ubiquitous in nature and industrial applications, and the understanding of their flow properties represents therefore a challenging technical problem. Although the dilute and semidilute rheological behaviors for suspension with a simple Newtonian matrix are well understood, when the solid concentration increases towards the maximum packing fraction several new issues arise. In dense systems particles under flow can get very close entering the lubrication regime [1].

From a computational perspective, reproducing correctly the lubrication interaction between two particles in a very thin separation gap is a very challenging task due to the singular character of the force. Issues of stability and accuracy in the lubrication problem has been recently solved by means of a novel and general semi-implicit splitting strategy which allows to integrate efficiently the particle equations of motion and speed-up drastically the simulations [2].

Another challenging fundamental aspect is represented by the choice of the lubrication model in the case the matrix is non-Newtonian. This is critical to extend the current simulations of dense systems towards complex suspending media. In this talk we will discuss novel models of lubrication forces in the case of dense particulate system suspended in shear-thinning media [3], pseudo-yield stress fluids [4] and possible extensions to discontinuous shear-thickening media. Some comparisons for the rheology of these systems with experimental data will be also provided.

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