Weekly CEAFM Seminar: Fall 2015

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Date:	**Friday, November 20, 2015**
Time:	11:00 AM
Location:	Gilman Hall # 132
Speaker:	**Prof. Luca Brandt** (Royal Institute of Technology - KTH)
Title:	***"Numerical Simulations of Finite Size Particles in Turbulent Flows"***

Abstract

We perform numerical simulations of suspensions of rigid spheres. An Immersed Boundary Method is employed to account for the dispersed solid phase, with collision and lubrication models. Analysis of the stress of the mixture of neutrally buoyant particles flowing in a plane channel enable us to identify 3 different regimes, each dominated by one of the three contributions to the total momentum transfer. A laminar regime at low volume fractions and Reynolds number, where viscous stresses are the main responsible for the total stress, a turbulent regime at higher Reynolds numbers and moderate volume fractions, dominated by the Reynolds stresses, and a regime denoted as inertial shear-thickening associated to intense particle stresses at high volume fractions. To further disentangle the role of particle and fluid inertia, we perform additional simulations varying the particle volume fraction and the fluid to particle density ratio while keeping the total mass fraction constant and neglecting settling. The results indicate that changes of the density ratio between 1 and 10 at constant volume fraction do not alter the turbulent statistics significantly. On the contrary, simulations at constant mass fraction and different volume fraction display significant modifications, which indicates that, in the parameter range investigated, the excluded volume effect is the main responsible of the modifications of the flow in the presence of the particles.

Finally, we will consider sedimentation of a dilute suspension in a quiescent and turbulent environment. The results show that the mean settling velocity is lower in an already turbulent flow than in a still fluid. Using the concept of mean relative velocity we estimate the mean drag coefficient from empirical formulas and show that non stationary effects, related to vortex shedding, explain the increased reduction in mean settling velocity in a turbulent environment.