MSc project

Simulating a cylinder in a Granular fluid

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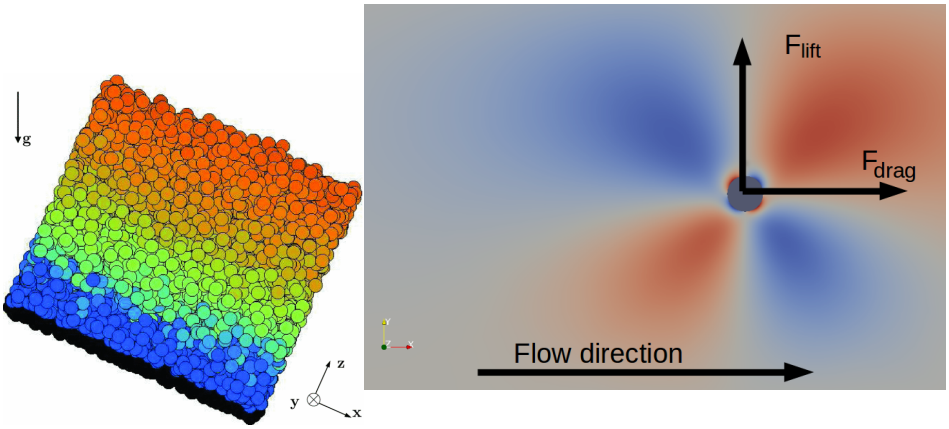
Motivation:
Granular flows are very common in nature and industry, with avalanches, mud flows and bulk transport of powders as common examples. These granular flows can be simulated by using simulation methods that resolve the particle trajectories and interactions, however there are restrictions on the number of particles in these simulations due to computational power. It is therefore preferred to simulate these flows by solving modified Navier-Stokes equations with a continuum method.
It is of interest to see what would happen if a large intruder, such as a cylinder, is added into the granular flow. Especially the lift and drag forces on these objects are of interest, to understand how large objects (such as lizards) can effectively move through a granular material. In order to be able to compute these lift and drag forces, it is of major importance to know the behaviour of the granular flow on the boundary of the large intruder.



Goal:
The goal of this project is to determine the boundary conditions for a range of problem parameters in the particle simulations, such as the friction and the velocity of the cylinder. These boundary conditions are then used to simulate the cylinder in a granular fluid using continuum simulations and the results are compared with the particle simulations.

Method:
Simulations of a cylinder in a granular flow are performed using a discrete particle method (DPM) that simulates all individual particles and their collisions. From the obtained results the boundary condition on the cylinder is determined. The granular fluid is then simulated by solving the granular Navier-Stokes equations using a Finite Element Method (FEM) and the boundary condition obtained from the DPM simulations.

Outlook:
Understanding how large objects move through a granular fluid increase the knowledge on the fundamental behaviour of granular materials.

Interested students are encouraged to contact Marnix van Schrojenstein Lantman at the above address