B.Sc. / M.Sc. THESIS PROJECT

MODELING "SNOWBALL" FLOW DOWN AN INCLINED PLANE

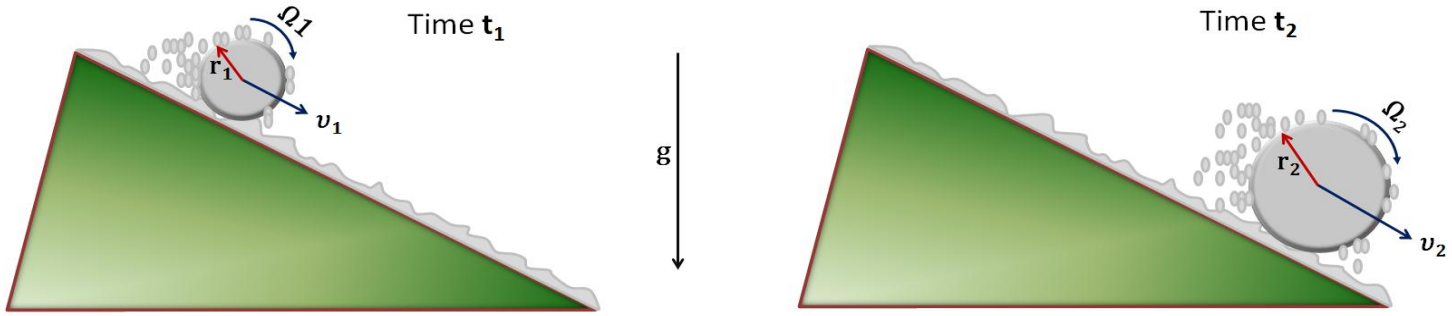
Sand, gravels, rice, sugar...granular matter is everywhere in our everyday life. Research in granular physics is motivated by numerous applications encountered in industrial processes and prediction of natural processes like snowball falling through a hill or hazards like landslides, rock avalanches or pyroclastic flows. Since granular media are composed of a large number of particles – for example, a spoon of sugar contains more than one million grains, which is larger than what we can compute numerically with ideal spherical particles – there is then a need for a continuous description, trying to define averaged quantities and to model granular media as a continuum.

Britain's runaway giant snowball pushed down the hill

Mysterious Ice Balls taking sunbath at Lake Michigan

In this project, we want to model the flow of cohesive materials (like a snowball) down an inclined plane with the surface made of the material itself and study the attachment/detachment process of the particles. The Discrete Element Method (DEM) will be used as the numerical tool to investigate the characteristics of these dense cohesive granular flows. A very simple table-top experiment should be made to understand how the radius, mass etc. of the ball changes as it flows down the plane and to see the effect of cohesion (cohesivity index), friction coefficient, plane angle etc. Furthermore, the predictive power of DEM to describe these phenomena will be verified by comparing simulation results with experimental findings. And finally, theoretical models should be developed to describe these flows starting from the simple Newton's second law viz.

$$\frac{d(m\vec{v})}{dt} = \vec{F}_{cohesion+friction+gravity+\cdots}$$



A cohesive ball rolling down an inclined plane at time t_1 (left fig.) and at time t_2 (right fig.) with increased radius

The project will mostly be carried out in the laboratory of the **Multi Scale Mechanics (MSM)** group headed by **Prof. Stefan Luding.** It will also include the opportunity to work with the research team together with other groups abroad.

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