



PhD project “Investigations of the influence of grain properties on jumps during free-surface granular flows”

Project summary

A great number of industrial and geophysical processes involve flows of granular materials with discontinuities in height, velocity and density. The impact of natural granular flows on protection barriers for instance produces such discontinuities, called granular jumps by analogy to the canonical case in hydraulics. Granular jumps are also observed in industrial applications that imply the transport of particles, e.g., during silo discharge problems or in pneumatic conveying systems. Recent research studies demonstrated the complexity of this physical process that appears during the transition, over a finite length, between a supercritical (rapid and fast) and a subcritical (thick and slow) flow. Traditional equations of hydraulics for those jumps do not take into account the compressibility nor the energy dissipation via friction, and thus show their limits for a range of granular jump patterns. A new theoretical framework that accounts for the finite length of the jumps and their internal kinematics needs to be developed. However, the internal kinematics and geometry of jumps, beyond the fact that they are driven by input conditions (mass discharge, slope angle), are both very dependent on the physical and mechanical grain properties. The relation between grain properties and jump features still remains poorly known. Investigating this challenging question will allow to advance the state of the art on the rheology of granular flows under well-controlled but highly non-uniform (standing jump) and transient (travelling jump) flow states.

Location and practical aspects

3 years PhD fellowship project, start: 1st October 2019

The successful applicant will be mainly hosted by the laboratory Irstea Grenoble in the ETNA team (Research Unit on Torrential Erosion, Snow & Avalanches). He/she will work under the joint-supervision of Dr Thierry Faug from Laboratory Irstea & Univ. Grenoble Alpes (UGA, France) and Prof. Itai Einav from the School of Civil Engineering of the Univ. of Sydney (USyd, Australia). A one year mobility of the applicant to the School of Civil Engineering will be considered under the frame of a PhD cotutelle agreement between UGA and USyd, which is a requirement to be awarded the double doctoral degree from UGA and USyd.

Qualifications of the applicant

The applicant should have preferably a formation in fluid and/or solid mechanics. It is desirable that the applicant has solid experience in mechanical numerical modelling, and/or experimental fluid mechanics. More specific skills in granular physics will be beneficial but not compulsory. The applicant should feel comfortable in learning or deepening numerical methods based on discrete element modelling and/or laboratory techniques using X-ray dynamic radiography applied to granular materials. Finally, the applicant should be fluent in scientific English.

Applications

Interested candidates should send their CV and cover letter to:

- Dr. Thierry Faug, thierry.faug@irstea.fr (+33 4 76 76 28 28)
- Prof. Itai Einav, itai.einav@sydney.edu.au (+61 2 93 51 20 69)

The closing date for applications is on **3 June 2019**, and more details on the project and how to apply can be found here:

http://www.adum.fr/as/ed/voirproposition.pl?langue=gb&site=edimep2&matricule_prop=25548#version