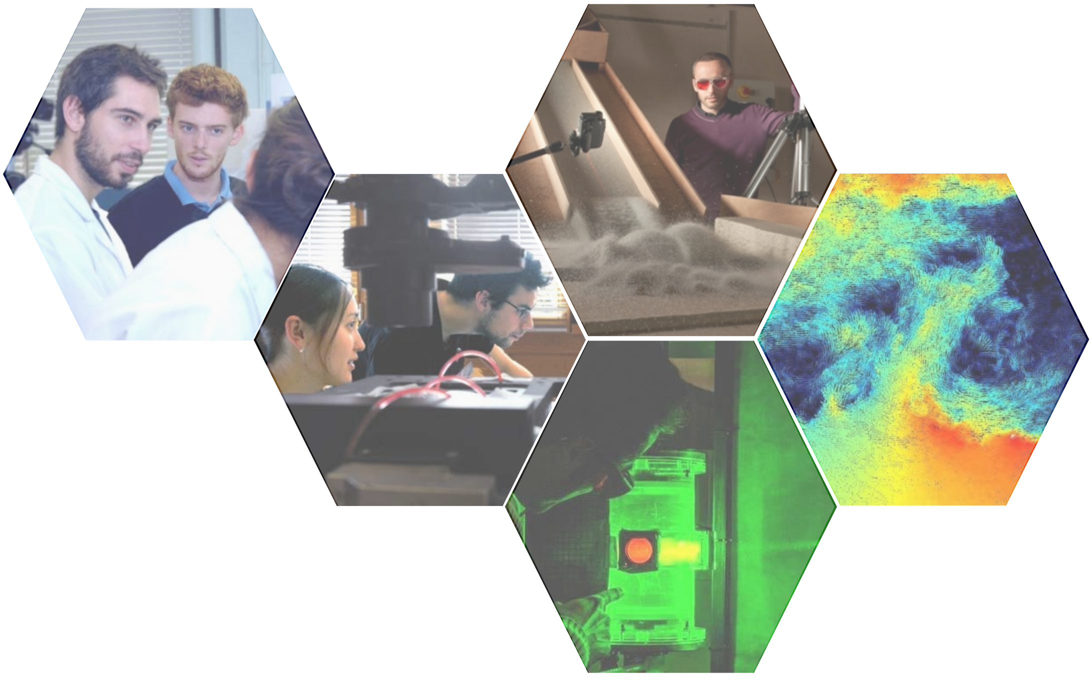
1st WINTER SCHOOL

MULTI SCALE APPROACHES AND MULTI PHYSIC COUPLINGS IN FLUID AND SOLID MECHANICS

GRENOBLE 15 – 20 JANUARY 2017



tec21 the engineering of complexity

FED

UNIVERSITÉ Grenoble Alpes

Communauté UNIVERSITÉ Grenoble Alpes

INVESTISSEMENTS D'AVENIR

1ST WINTER SCHOOL

MULTI-SCALE MODELING AND MULTI-PHYSICS COUPLINGS IN SOLID AND FLUID MECHANICS

Grenoble 15 - 20 January 2017

tec21 the engineering of complexity

Important societal issues require to solve increasingly complex problems in mechanical and process engineering. A key vector of progress relies on multi-scale and multi-physics approaches. The aim of this winter school is to make an overview of the different approaches, advanced numerical and experimental techniques allowing to tackle this complexity. All the courses will be illustrated through various recent examples. Two days will be dedicated to practical exercises on « high tech demonstrators » based on the most up-to-date techniques and methods developed by the partner laboratories of Tec21. Finally on Friday, invited lecturers will give a focus on « advanced tools and methods for the study of multiscale problems ».

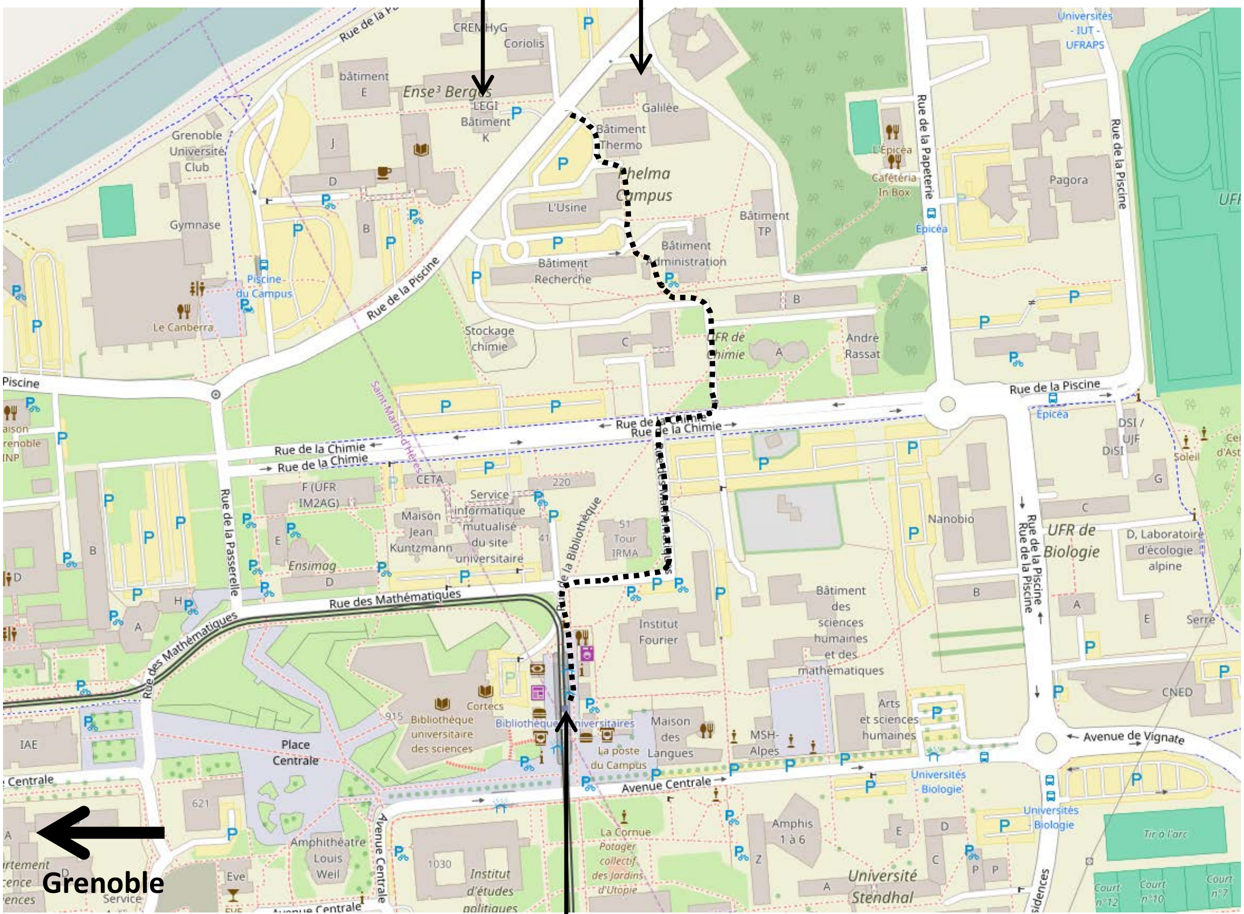
VENUE: LEGI Building K, Room 118, 1209-1211 rue de la Piscine - 38400 Saint Martin d'Hères

	Monday Multiscale approaches in mechanics	Tuesday Numerical and experimental tools and methods	Wednesday High-tech lab-courses (8 parallel sessions)	Thursday High-tech lab-courses (8 parallel sessions)	Friday Advanced tools & methods for the study of multiscale problems
9:00	Turbulent flows	Turbulence metrology	Turbulence and particle transport Granular and porous materials	Turbulence and particle transport Granular and porous materials	Invited lectures Stephen Hall (Lund Univ.) Jacques Desrues (Univ. Grenoble Alpes)
10:50	Multiphase flows	Numerical prediction of turbulent flows	Mechanics of blood circulation Dense flows	Mechanics of blood circulation Dense flows	Andreas Schroeder (German Aerospace Center)
12:30	Buffet lunch served from 12:30 to 14:00 every day in the lobby of the Galilée Building				
14:00	Rheology of suspensions	Advanced experimental solid mechanics	Mechanics of fibrous materials Biobased composites	Mechanics of fibrous materials Biobased composites	Olivier Desjardins (Cornell Univ.) Julien Chauchat (Grenoble INP)
15:50	Homogenisation of heterogeneous materials	Advanced numerical solid mechanics	Wave turbulence Rheology of suspensions	Wave turbulence Rheology of suspensions	Claude Verdier (CNRS)
	17:30 « Apéritif » and poster session			20:00 Dinner in town	

Map of the University Campus and the Surroundings

LEGI Building K
1209 – 1211 rue de la piscine

Galilée Building
1270 rue de la piscine



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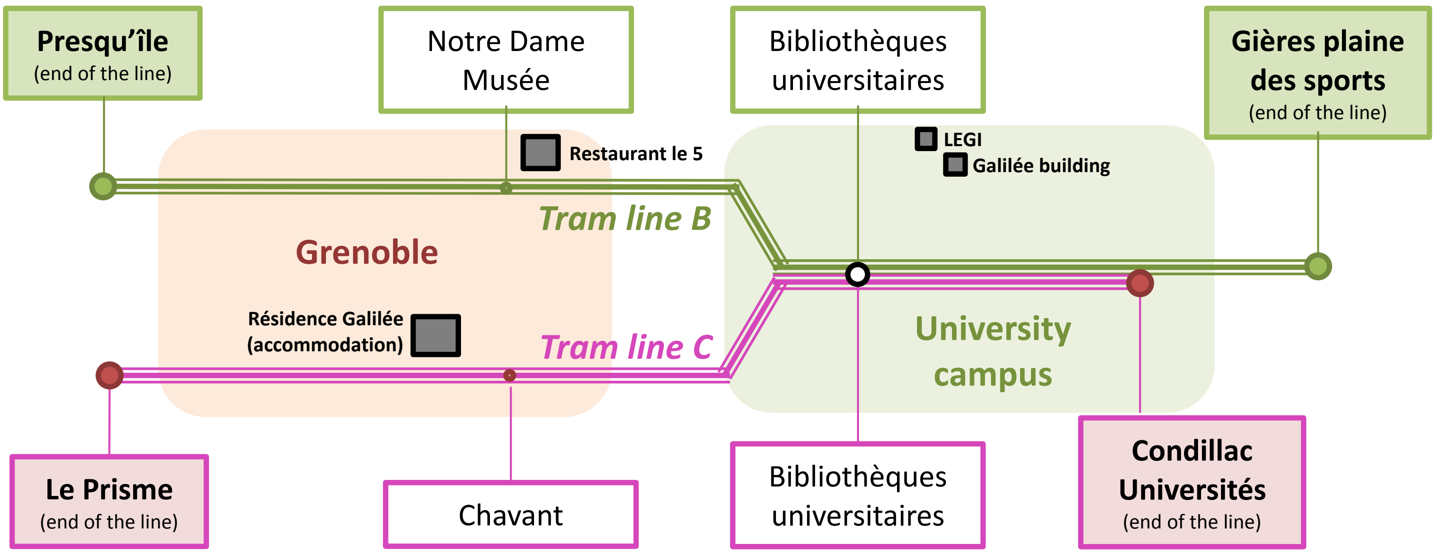


MONDAY 16, JANUARY 2017 LEGI BUILDING K, ROOM 118

MULTISCALE APPROACHES IN MECHANICS

8h15 - 8h45 *Coffee*

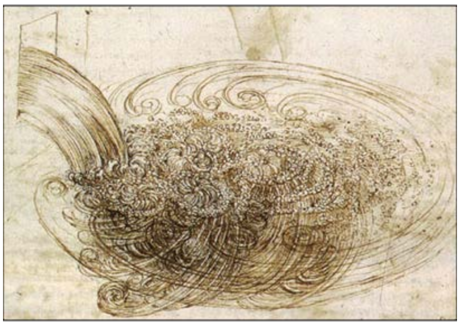
8h45 - 9h00 Introduction to the Winter School

Christian Geindreau
(Univ. Grenoble Alpes, 3SR Lab, Director of the Fédération Galileo Galilei de Grenoble)

9h00 - 10h30 A brief introduction to fluid turbulence

Mickaël Bourgoin
(CNRS, LMFA – Lyon)

Abstract: In spite of centuries of active research Turbulence remains one of the deepest mysteries of fluid mechanics. The complexity relies on the random and multi-scale nature of the phenomenon. This lecture will review the origin and the characteristics of fluid Turbulence, as well as the phenomenological framework and statistical tools commonly used to describe the phenomenon. These rely on the concept of energy cascade, introduced by L. Richardson in the 1920's, later refined by A. Kolmogorov, who's ideas still dominate the Turbulence research community

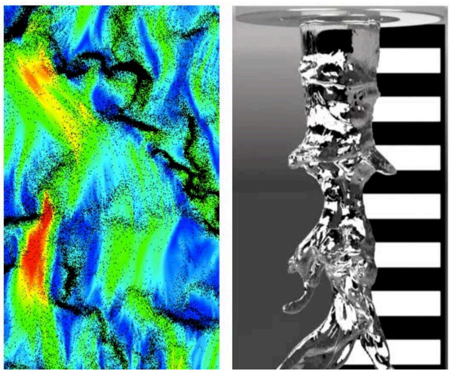


10h30 - 10h50 *Coffee break*

10h50 - 12h20 Multiscale phenomena in multiphase flows

Olivier Desjardins
(Cornell University, USA)

Abstract: In engineering and environmental fluid flows, the presence of multiple interacting phases is ubiquitous. One phase can be dispersed into another (e.g., solid grains in gas), or both phases can be continuous, separated by a phase interface (e.g., liquid-gas flow). In both cases, the resulting flow is often turbulent, and spans many characteristics scales. Multiphase flows exhibit processes at the microscale such as inter-particle collisions and droplet coalescence, and flow dynamics on significantly larger scales such clusters in particle-laden flows and instabilities in liquid-gas flows.



12h20 - 14h00 *Lunch (Gallilée Building, 1270 rue de la piscine)*

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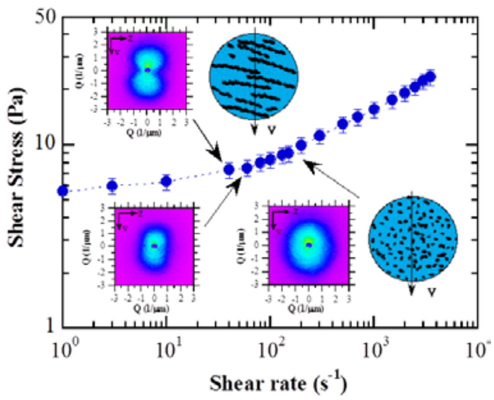
MONDAY 16, JANUARY 2017

MULTISCALE APPROACHES IN MECHANICS

14h00 - 14h45 **Rheology of suspensions - Structure and flow properties of colloidal suspensions: combination of in-situ scattering and rheometric techniques**

Frédéric Pignon (CNRS, LRP - Grenoble)

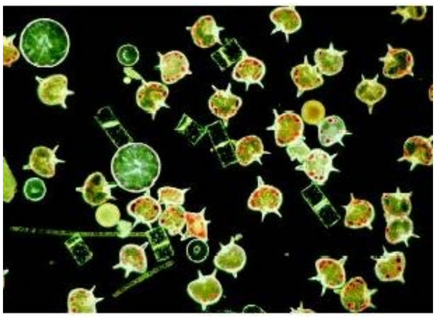
Abstract: courses objectives are the characterization of the link between the flow mechanical properties (flow field, shear or extensional stresses, viscoelasticity moduli) and the structural organizations (aggregation, orientation, phase changes). The goal is to bring an understanding of the mechanisms controlling the flows properties of colloidal dispersions used in several processes (membrane separation, extrusion, film casting) involved in several industrial applications (chemical, bio- and agro-industries, pharmaceutical, water treatment,…)



14h45 - 15h30 **Hydrodynamics of suspensions – When particles come to life**

Philippe Peyla
(Université Grenoble Alpes, LIPhy)

Abstract: Suspensions refer to particles immersed in a liquid like mud, fresh concrete, blood, paints, inks... They are encountered in nature as well as in various industrial processes. A very recent interest concerns active suspensions where particles can actively swim in the liquid phase like planktonic suspensions. Usually, the small size of the particles means that the surrounding flow is dominated by viscous effects, and inertial forces can be neglected. The Reynolds number associated with the particles is small and the flow can be considered as a Stokes flow. The present course aims at providing a physically based introduction to the dynamics of particulate suspensions and focuses on hydro-dynamical aspects. We will also briefly summarize recent researches concerning active suspensions.



15h30 - 15h50 *Coffee break*

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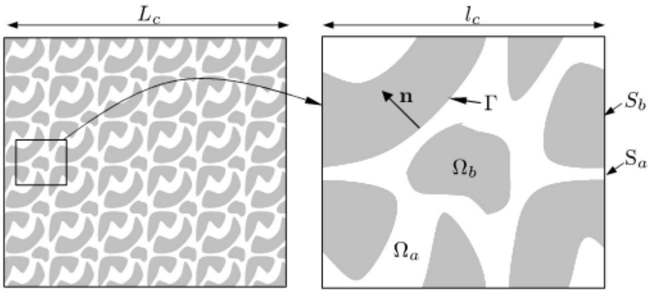
Grenoble

MONDAY 16, JANUARY 2017

MULTISCALE APPROACHES IN MECHANICS

15h50 – 17h20 **Homogenization of coupled phenomena in heterogeneous materials**

Christian Geindreau
(Université Grenoble Alpes, 3SR Lab)



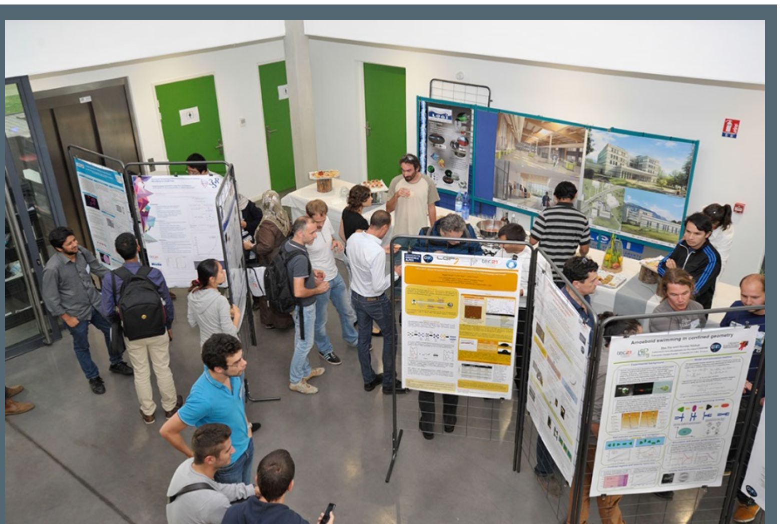
Abstract: The macroscopic mechanical behaviour of heterogeneous material strongly depends on the arrangement of the constituents according to various microstructures (granular or porous media, fibrous network) and the physical phenomena involved at the microscale (heterogeneity scale). A fine scale description of such material is often impossible due to the large number of heterogeneities. In practice, a macroscopic equivalent modelling is more efficient. An overview of the different methods that can be used to derived such equivalent macroscopic behaviour is given.

17h30 – 20h00

Cocktail and poster session

Gallilée Building
1270 rue de la Piscine
38400 Saint Martin d’Hères

Across the street right the opposite the LEGI building



TUESDAY 17, JANUARY 2017 LEGI BUILDING K, ROOM 118

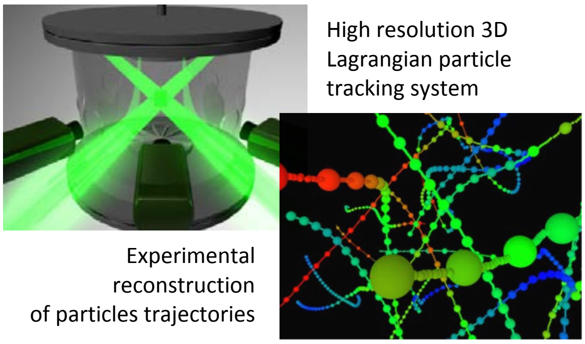
NUMERICAL AND EXPERIMENTAL TOOLS AND METHODS

8h30 - 9h00 *Coffee*

9h00 - 10h30 A brief review of turbulence metrology

Mickaël Bourgoin
(CNRS, LMFA – Lyon)

Abstract: Because of its intrinsic multi-scale nature, the experimental characterization of turbulence requires dedicated metrological tools, capable to resolve (simultaneously if possible) the whole range of relevant involved scales (both in time and space). The present lecture will review the main contemporary instruments used by the scientific community for such high resolution and multi-scale diagnosis. These include Eulerian methods (such as hot-wire anemometry, laser-Doppler velocimetry and Particle Image Velocimetry) as well as new Lagrangian methods, based on acoustical and optical 3D particle tracking.



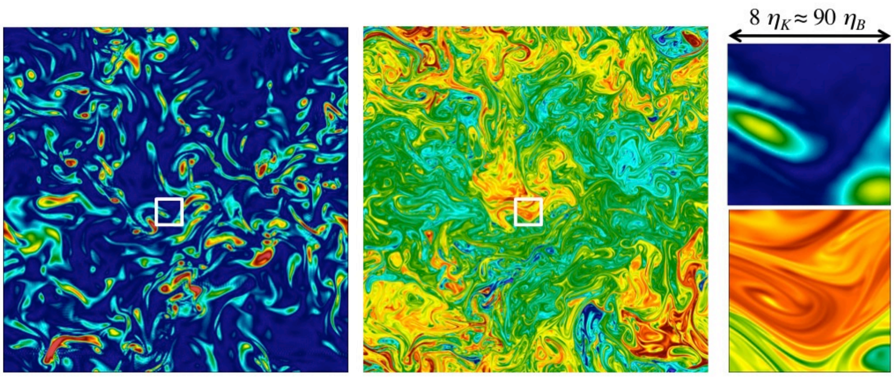
High resolution 3D Lagrangian particle tracking system

Experimental reconstruction of particles trajectories

10h30 - 10h50 *Coffee break*

10h50 - 12h20 Numerical prediction of turbulent flows

Guillaume Balarac
(Grenoble-INP, LEGI)



Abstract: Turbulent flows are characterized by a large range of motion scales. When turbulent flows are studied by numerical simulations, the explicit discretization of the overall range of scales is still an issue, even with the exponential rise in computational capability over the last few decades. In this presentation, some methods to overcome this limitation will be presented. The methods can consist to model a part of the turbulent fields (RANS and LES approaches), but the methods can also consist to develop numerical algorithm to allow direct numerical simulation with a lower computational cost (hybrid method for turbulent mixing).

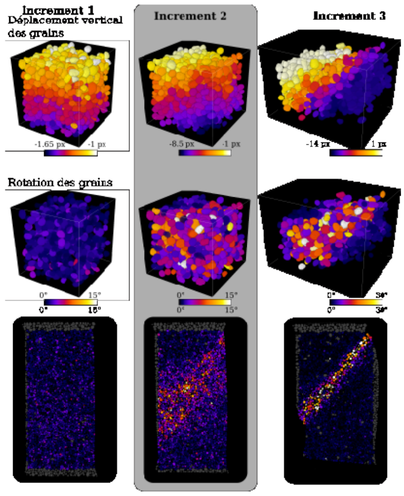
12h20 - 14h00 *Lunch*

TUESDAY 17, JANUARY 2017

NUMERICAL AND EXPERIMENTAL TOOLS AND METHODS

14h00 – 15h30 **Full-field methods and multi-scale approaches in experimental solid mechanics**

Cino Viggiani
(Université Grenoble Alpes, 3SR Lab)

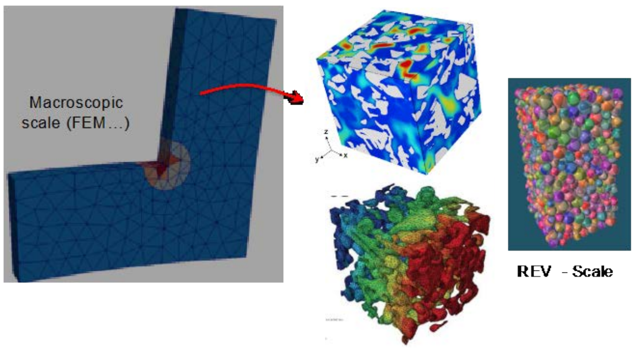


Abstract: Various advanced modeling approaches have been proposed to describe intriguing phenomena in solid mechanics, including: higher-order continuum approaches to characterize, for example, strain localization; multi-scale approaches involving homogenization of explicitly modeled micro-scale mechanics; discrete element models that attempt to model granular systems from the grain-scale upwards. However, such models require experimental results, at the appropriate scales, with the appropriate sensitivities and under the appropriate loading conditions, to identify and characterize the important mechanisms controlling the material responses, to provide ground truth and to identify model input parameters. Unfortunately, traditional experimental methods often fall short of providing the necessary data for the increasingly ambitious modeling approaches. To address such shortcomings, new (advanced) experimental methods have been under development in recent years. This lecture summarizes some of the key developments in this area, with specific examples mostly (but not only) from geomechanics.

15h30 - 15h50 *Coffee break*

15h50 – 17h20 **Numerical investigations of macroscopic behaviour of heterogeneous materials**

Bruno Chareyre
(Grenoble-INP, 3SR Lab)



Abstract: The macroscopic effective properties or behaviour of heterogeneous materials are commonly invstigated by solving specific boundary value problem on Representative Elementary Volume (i.e. at the microscale) arising from the homogenization process. Nowadays, these boundary value problems (BVP) are commonly solved on 3D images of the material obtained by microtomography or idealized microstructure. Different numerical methods (Finite volume differences, Finite Element method, Discret Element method…) can used to solved the BVP. An overview of these methods is presented and illustrated.

Wednesday 18, January 2017

High Tech lab courses

8 high-tech lab courses are proposed and will be held in parallel sessions on Wednesday and Thursday. Each participant will attend two of them, one on Wednesday, the other one on Thursday.

All the participants and the teachers in charge of the lab-courses will meet at 8:30 at the LEGI for the coffee.

8h30 - 9h00 *Coffee*

9h00 – 12h20 **Practical sessions**

12h20 - 14h00 *Lunch*

14h00 – 18h00 **Practical sessions**

Thursday 19, January 2017

High Tech lab courses

8h30 - 9h00 *Coffee*

9h00 – 12h20 **Practical sessions**

12h20 - 14h00 *Lunch*

14h00 – 18h00 **Practical sessions**

20h00 *Gala dinner*

Restaurant “Le 5”,
5 place Lavalette
38 000 Grenoble
Right near the Art Museum of Grenoble.

Tram line B, stop at “Notre Dame Musée”
(15 minutes from the university campus)

DESCRIPTION

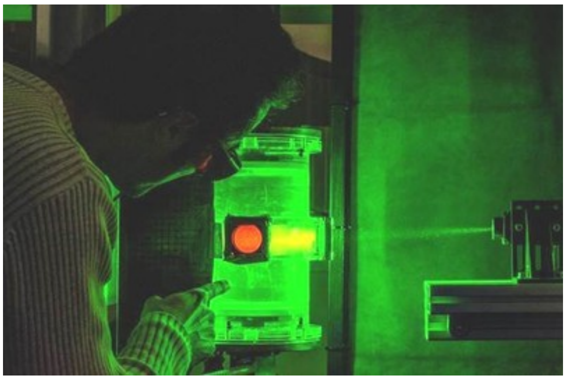
OF THE HIGH TECH LAB COURSES

Lab Course # 1 **Initiation to fluid turbulence**


Henda Djeridi
(Grenoble-INP, LEGI)


Nicolas Mordant
(Univ. Grenoble Alpes, LEGI)

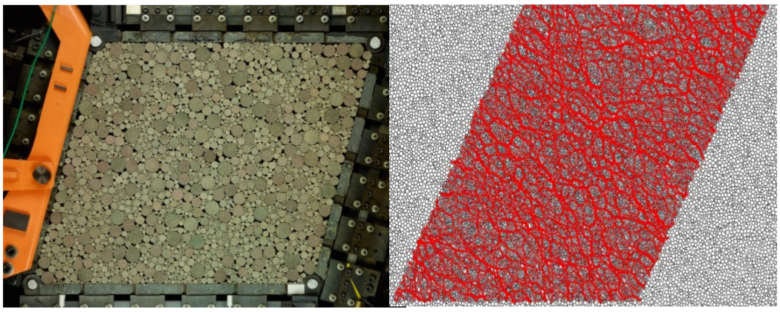

Guillaume Balarac
(Grenoble-INP, LEGI)



Turbulence is a canonical example of multi scale phenomenon. This multi scale character is actually at the very center of the phenomenological theory of turbulence by Kolmogorov. During this lab course, the trainees will be initiated to the PIV (Particle Image Velocimetry) measurement technique that provides 2D spatial maps of a flow or to hot wire anemometry. We will focus on the wake behind a simple object like a cylinder. This introduction to major experimental techniques in fluid mechanics (and to their limitations) will be augmented by an initiation to numerical techniques (and the issues associated to them) such as direct numerical simulations, RANS method, or Large Eddy Simulations.

Lab Course # 2 **Experimental and numerical behaviour of granular media – multiscale analyses**


Gaël Combe
(Univ. Grenoble Alpes, 3SR Lab)



In this practical session, we will perform shear tests on a 2D granular media with the help of the device called 1γ2ε. This unique apparatus allows to apply various loading paths on granular assemblies made of rods. By means of a 80 MPixels camera, discrete kinematics field will be assessed and analyzed. Comparisons between experimental and numerical simulations by means of Discrete Element Modeling will also be performed. The multiscale kinematic behavior will then be discussed.

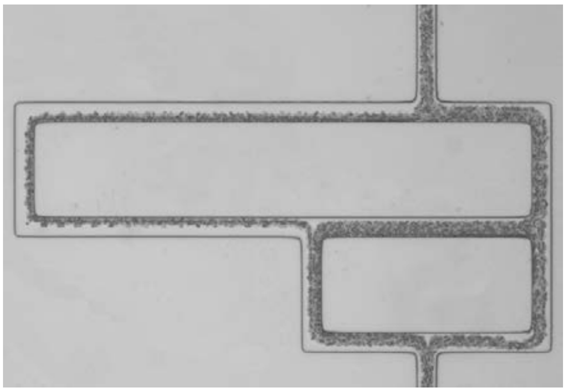
Description

OF THE HIGH TECH LAB COURSES

Lab Course # 3 **Red blood cells distribution in a model network**

Gwennou Coupier
(CNRS, LIPhy)

One of the functions of the vascular system is to bring oxygen to the body via the red blood cells. The vascular system consists of a large number of vessels subdividing themselves in increasingly small vessels, where the distribution in cells is highly heterogeneous. The purpose of this practical work is to measure these heterogeneities in a simplified artificial network, where real blood samples will be injected. The results will then allow comparison with existing models from the literature.



Lab Course # 4 **Dense gravitational flows**

Thierry Faug
(IRSTEA, ETNA)

Mohammed Naaim
(IRSTEA, ETNA)

Guillaume Chambon
(IRSTEA, ETNA)

The aim of this lab-course is to tackle the problem of the modeling of dense gravitational flows dynamics. Dense avalanches of granular materials will be produced and analyzed with the help of a laboratory inclined plane equipped with advanced instrumentation: granular PIV, fringe projection, etc. The experimental granular avalanche-flows will then be reproduced by numerical simulations based on shallow-flow (Saint-Venant) equations. Emphasis will be placed on comparing the propagation and final stopping of laboratory and numerical avalanche-flows, with the objective to infer the relevant rheological parameters of the studied granular fluid.

(Credit: H. Raguet)

DESCRIPTION

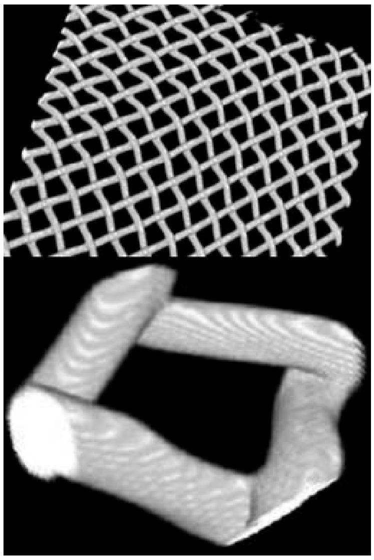
OF THE HIGH TECH LAB COURSES

Lab Course # 5 Investigation of fibrous materials behaviour using X ray tomography


Sabine Rolland du Roscoat
(Univ. Grenoble Alpes, 3SR Lab)


Laurent Orgéas
(CNRS, 3SR Lab)

The aim of this module is to emphasize the interest of coupling 3D imaging and fine scale fluid flow simulation to estimate the both the microstructures and the permeability of fibrous reinforcements commonly used in fiber reinforced composites or geotextiles . A woven fabric will be subjected to a tensile loading with a mechanical testing machine placed inside a X-ray microtomograph, allowing the 3D in situ observations of the fibrous microstructure of the textile during its deforrmation. The microstructure will be then finely characterized using 3D image analysis subroutines provided by the freeware ImageJ (Fiji).
Therefrom, the permeability of the initial and deformed fibrous reinforcements will be estimated from fluid flow simulation inside the imaged fibrous microstructures using a finite volume CFD software (GeoDict).



Lab Course # 6 Preparation and thermo-mechanical characterization of thermoplastic bio-based polymers and composites


Julien Bras
(Grenoble-INP, LGP2)


Marie-Alix Berthet
(Grenoble-INP, LGP2)

This practical course is organized in 2 parts. The first one deals with processing of different bio-based materials using different techniques like twin-screw extrusion or thermopressing. Biodegradable polymers and natural fiber will be performed. A 3D converting using thermopressing might be expected. The second part of the practical work will focus onto biocomposites characterization using DMA and DSC in order to check the influence of fibre addition onto end-use materials properties.

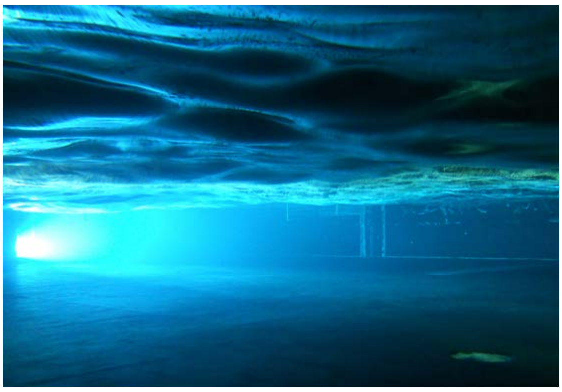
DESCRIPTION

OF THE HIGH TECH LAB COURSES

Lab Course # 7 Wave turbulence

Nicolas Mordant
(Univ. Grenoble Alpes, LEGI)

Wave turbulence is a statistical state that aims at describing the nonlinear random ensemble of waves as commonly observed at the surface of the ocean. Here we will experiment on a physical model for wave turbulence: the vibrating elastic plate in which a state of wave turbulence is obtained by shaking a thin steel plate at low frequency. In this lab-course, turbulence will be observed and measured using imaging tools, and a numerical simulation of the vibrating plate will be carried out to further investigate the behaviour of wave turbulence.

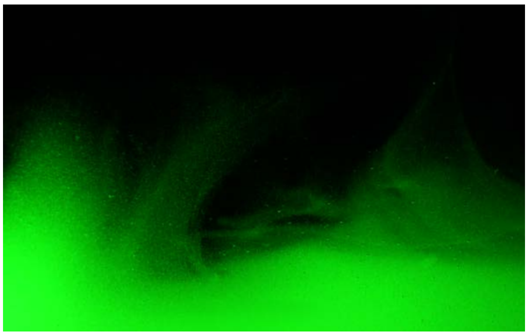


Lab Course # 8 Rheology of suspensions

Frédéric Pignon
(CNRS, LRP)

Nicolas Hengl
(Univ. Grenoble Alpes, LRP)

The purpose of this lab course is to give the attendants the opportunity to discover the mechanisms involved in membrane ultrafiltration processes in relation with the rheological behavior of the aqueous filtered suspensions. During the filtration process under shear flow and pressure forces, the filtered particles accumulate near the membrane surface forming a concentrated layer of a few hundred micrometers. The changes from a dilute phase to a concentrated phase induce a change in the rheological behavior of the suspensions which control the performance of the process.



The proposed approach is to combine the characterization of the filtration properties of the suspensions, the in-situ visualization of the accumulated layers and the rheometric behavior of the suspensions. The goal is to understand the principal mechanisms governing the ultrafiltration process.

tec21 Winter School 2017 Grenoble

Friday 20, January 2017

Advanced tools and methods for the study of multiscale problems

Programme of the day

8h30 - 9h00 *Coffee*

9h00 – 9h55 **Investigations of (hydro)mechanical behaviour of granular geomaterials from the intra-grain scale to the sample scale using x-ray and neutron imaging and diffraction**
Speaker: Stephen Hall, Univ. Lund

9h55 - 10h50 **FEMxDEM double scale integrated approach in geomechanics**
Speaker: Jacques Desrues, CNRS

10h50 - 11h15 *Coffee Break*

11h15 - 12h10 **Dense Lagrangian particle tracking for turbulence research**
Speaker: Andreas Schroeder, German Aerospace Center (DLR)

12h10 -13h40: *Lunch*

13h40 -14h35 **Computational methods for simulating multiphase turbulence**
Speaker: Olivier Desjardins, Cornell Univ.

14h35 -15h15 **Investigation of turbulent sheet flows under unidirectional flow forcing**
Speaker: Julien Chauchat, Grenoble-INP

15h15 -15h55 **Multiscale characterization of soft biological systems using AFM**
Speaker: Claude Verdier, CNRS

15h55 **Closing remarks**

FRIDAY 20, JANUARY 2017

ADVANCED TOOLS AND METHODS FOR THE STUDY OF MULTISCALE PROBLEMS

INVITED LECTURES

Investigations of (hydro)mechanical behaviour of granular geomaterials from the intra-grain scale to the sample scale using x-ray and neutron imaging and diffraction

Stephen Hall
(Univ. Lund, Sweden)

Abstract: Geomaterials are complex multiscale materials with deformation mechanisms occurring over a range of scales. In granular geomaterials, e.g., sands and sandstones, the basic building blocks are the grains that interact with each other at contacts across which forces are transferred. The grains also move relative to each other during shearing, dilation or compaction. How the grains interact and how force transfer across contacts is organised during these processes control the overall material response. At a scale above the grain scale, strains, when the system is regarded as a continuum, generally localise, e.g., in to shear bands, a few grains wide, depending on the grain interactions. The organisation of such localised features and the deformation or damage associated with them will impact on the macroscopic properties and behaviours. For example, shear-bands in rocks can provide conduits or barriers to fluid flow that have implications for processes such as CO2 sequestration. New tools are required to probe these complex, coupled, multi-scale processes and interactions within the body of bulk samples and whilst the samples are contained under realistic experimental conditions. X-ray and neutron scattering and imaging techniques provide many possibilities for such investigations due to the ability to penetrate deep into materials. Both x-rays and neutrons have their advantages and disadvantages for different types of studies, due to different interaction mechanisms with different components of the study material and experimental system. Furthermore, when used in combination x-rays and neutron can reveal many new features of material behaviour. In this presentation an overview will be provided of the possibilities of using X-ray and neutron scattering and imaging techniques to probe geomaterial properties and processes with illustrations from different recent experiments.

FRIDAY 20, JANUARY 2017

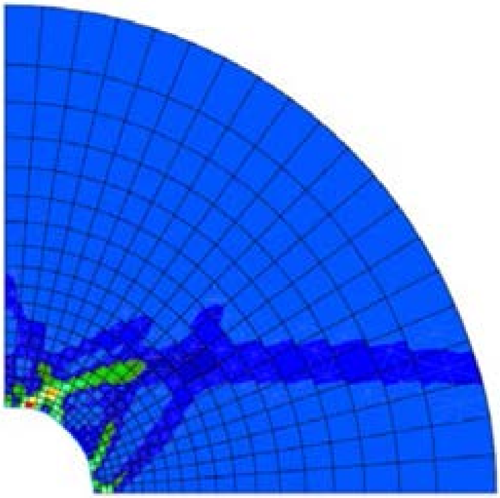
ADVANCED TOOLS AND METHODS

FOR THE STUDY OF MULTISCALE PROBLEMS

INVITED LECTURES

FEMxDEM double scale integrated approach in geomechanics

Jacques Desrues
(Univ. Grenoble Alpes, 3SR lab)



Recently, multi-scale analysis using a numerical approach of the homogenisation of the microstructural behaviour of materials to derive the constitutive response at the macro scale has become a new trend in numerical modelling in geomechanics. Considering rocks as granular media with cohesion between grains, a two-scale fully coupled approach can be defined using FEM at the macroscale, together with DEM at the microscale [1,2,3]. In this approach, the micro-scale DEM boundary value problem attached to every Gauss point in the FEM mesh, can be seen as a constitutive model, the answer of which is used by the FEM method in the usual way. A first major advantage of two-scale FEM-DEM approach is to allow one to perform real-grain-size micro-structure modelling on real-structure-size macroscopic problems, without facing the intractable problem of dealing with trillions of grains in a fully DEM mapped full-field problem. A second one is that using this approach, microscale related features such as the inherent and induced anisotropy of the material, or material softening/hardening with strain, naturally flow from the microscale DEM model to the macroscale FEM model. Arguably, multi-scale numerical approaches may suffer from computational cost penalty with respect to mono-scale one. However, high performance computing using parallel computation schemes offers solutions to mitigate the computational cost issue. An implementation of the FEM-DEM method in a well-established, finite strain FEM code is presented, and representative results are discussed, including aspects related to strain localisation in this context. High Performance Computing implementation and performances are illustrated.

FRIDAY 20, JANUARY 2017

ADVANCED TOOLS AND METHODS FOR THE STUDY OF MULTISCALE PROBLEMS

INVITED LECTURES

Shake-The-Box – Dense Lagrangian particle tracking for turbulence research

Andreas Schroeder
(German Aerospace Center - DLR)

Shake-The-Box (STB) is a novel time-resolved 3D Lagrangian particle tracking method for densely seeded flows. The STB algorithm has been developed at DLR Göttingen in the past three years and uses the prediction of 3D particle distributions for each subsequent time-step as a mean to seize the temporal domain for accurate track reconstructions based on time series of particle images from few camera projections. Exploiting the temporal information enables the processing of densely seeded flows (up to and beyond 0.1 particles per pixel with a nearly complete suppression of ghost particles). Such high particle trajectory densities are a necessary precondition for interpolating the corresponding time-resolved 3D velocity vector field onto a regular grid using Navier-Stokes-constraints. Such a non-linear data assimilation method named FlowFit has been developed at our group in parallel to STB and tested already successfully: For example, unsteady 3D pressure distributions have been calculated from interpolated 3D acceleration fields. The STB method has been applied to wall bounded turbulence in air and water and to a m³-scale experiment using Helium–Filled-Soap-Bubbles (HFSB) as tracers. The results demonstrate that with STB valuable data for turbulence characterization with outstanding temporal and spatial resolution especially in (wall bounded) shear flow can be obtained.

Figure caption: Dense Lagrangian tracks (~300,000 per time step) colour coded by velocity and iso-contours of Q-values from STB measurements (and Flow-Fit interpolation) in a large scale thermal plume using HFSB

FRIDAY 20, JANUARY 2017

ADVANCED TOOLS AND METHODS

FOR THE STUDY OF MULTISCALE PROBLEMS

INVITED LECTURES

Computational methods for simulating multiphase turbulence

Olivier Desjardins
(Cornell University, USA)

Multiphase flows are ubiquitous in environmental and engineering applications. One category of flow of great importance in energy conversion devices is the formation of a liquid spray, a process called atomization. Due to their nonlinear and multiscale nature, such liquid-gas flows present a significant modeling challenge, especially when novel control strategies such as electro-hydrodynamics are considered. In addition, flow variables exhibit discontinuities across the phase interface, leading to numerical difficulties. Another category of flow of importance for energy conversion is dense particle-laden flows, as found in fluidized bed reactors. These flows are strongly multiscale, and momentum coupling between the gas carrier phase and finite-sized particles can lead to the production of gas-phase kinetic energy fluctuations, leading to cluster-induced turbulence which needs to be modeled.
With the advent of more powerful computing resources, simulating such flows from first principles is becoming viable. As with single-phase flows, numerical methods need to be carefully designed to guarantee convergence under grid refinement, primary conservation of key quantities such as mass and momentum, and excellent parallel performance. We will discuss how such properties can be obtained in the context of various multiphase turbulent flows, including atomizing liquid jets and fluidized beds, as well as three-phase flows.

tec21
Winter School 2017
Grenoble

FRIDAY 20, JANUARY 2017

ADVANCED TOOLS AND METHODS

FOR THE STUDY OF MULTISCALE PROBLEMS

INVITED LECTURES

Investigation of turbulent sheet flows under unidirectional flow forcing

Julien Chauchat
(Grenoble-INP, LEGI)

Abstract: During this seminar I will present some recent research activities concerning the modeling of intense bed-load transport usually denoted as sheet-flow. This sediment transport regime is especially important for the morphological evolution of natural systems like rivers or sandy beaches. Our overall objective is to provide a better understanding and modeling of the physical processes involved at fine scales. In order to achieve this goal we have developed a one-dimensional two-phase flow model of this problem in which the particle-particle interactions are modeled based upon the recent mu(I) dense granular flow rheology and we have developed a new experimental setup to acquire High Resolution measurements of velocity and concentration profiles under such flow conditions. The measurements have been obtained using the Acoustic doppler Concentration and Velocity Profiler (ACVP) developed by D. Hurther at LEGI.

After a brief introduction of the dense granular flow rheology mu(I), I will present the two-phase flow model and some first results that illustrate the relevancy of the granular rheology for modeling sheet flow. In the last part I will report on the sheet flow experiments. The new dataset tends to show that a liquid granular regime (mostly frictional) caped by a gaseous one (mostly collisional) is observed. The turbulent measurements show that a log layer exists however the Von Karman is reduced by a factor of two under sheet flow conditions and that the turbulent Schmidt number is around 0.44 for a settling velocity to bed friction velocity ratio around unity. Last but not least, a very strong intermittency has been observed in the sheet flow layer in terms of both sediment flux and bed interface position. This intermittency is most probably linked with the large scale coherent shear stress structures of the boundary layer. This observation is not compatible with the hypotheses made in turbulence averaged two-phase flow model and requires eddy resolving simulations (LES) to further understand the complex couplings between the turbulent boundary layer and the sediment bed dynamic.

FRIDAY 20, JANUARY 2017

ADVANCED TOOLS AND METHODS

FOR THE STUDY OF MULTISCALE PROBLEMS

INVITED LECTURES

Multiscale characterization of soft biological systems using AFM

Claude Verdier
(CNRS, LIPhy)

Abstract: Coming soon

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