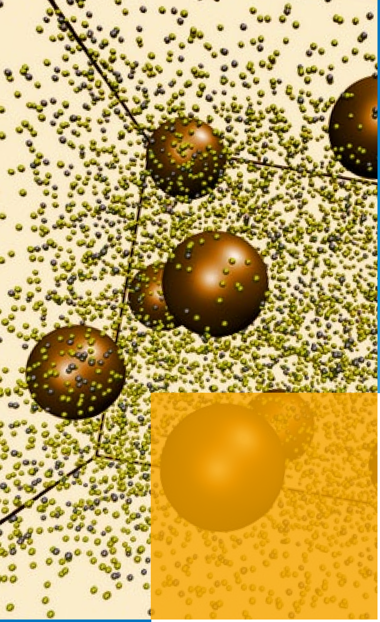

SFB 716

University of Stuttgart
Germany

47th SFB 716 Colloquium

January 30, 2014 | 4 pm

University of Stuttgart
Campus Vaihingen
Allmandring 3
Room 1.079

The Collaborative Research Center (SFB) 716 invites colleagues and interested person to the upcoming colloquium. In this lecture series renowned researchers and members of our subprojects talk about their research findings regarding dynamic simulation of systems with large particle numbers.

TALK

Dr. Stefan Luding

Universität Twente (NL), Multi Scale Mechanics, Faculty of Engineering Technology

About particles, micro-macro, and continuum theory: shear-bands, memory of jamming and dilatancy

Particulate systems are posing many challenges for theory and applications. From molecular dynamics simulations of many atoms or particles, one can extract scalar fields like density or temperature, as well as velocity, i.e. vectorial fields, or tensors like stress, strain, and structure (fabric). Given sufficiently good statistics the data can have a quality that allows to derive constitutive relations about the rheology and flow behavior of complex fluids (like atoms confined in nano-geometry, or granular particle systems) that behave strongly non-Newtonian, with particular relaxation behavior, anisotropy etc. [1]. With attractive forces involved, this leads to cohesion added on top of the already non-trivial dynamics of granular matter [2]. Dependent on the energy input (shear-rate), the particles can flow like a fluid, jam and un-jam, or be solid with a very interesting anisotropic structure (contact-and force-networks). The interplay between strain, stress and anisotropy leads to dilatancy and an interesting 'memory' of the packing: the evolution of anisotropy is independent from anisotropy of stress, both in evolution rates as well as in direction, i.e., tensorial eigensystem orientations.

The presentation will show the basic approach to coarse graining following the ideas of Isaac Goldhirsch [3,4,5] towards the micro-to-macro transition towards constitutive relations obtained from micro/atomistic/particle simulations. Examples involve the split-bottom ring shear cell [1,2] and inclined plane avalanche flows [4,5].

[1] S. Luding, The effect of friction on wide shear bands, Particulate Science and Technology 26(1), 33-42, 2008

[2] S. Luding and F. Alonso-Marroquin, The critical-state yield stress (termination locus) of adhesive powders from a single numer. experiment, Granular Matter 13(2), 109-119, 2011

[3] Goldhirsch. Stress, stress asymmetry and couple stress: from discrete particles to continuous fields. Granular Matter, 12:239–252, 2010

[4] T. Weinhart, R. Hartkamp, A. R. Thornton, and S. Luding, Coarse-grained local and objective continuum description of 3D granular flows down an inclined surface, Phys. Fluids 25(6), in press, 2013

[5] T. Weinhart, A. R. Thornton, S. Luding, and O. Bokhove, From discrete particles to continuum fields near a boundary, Granular Matter 14(2), 289-294, 2012

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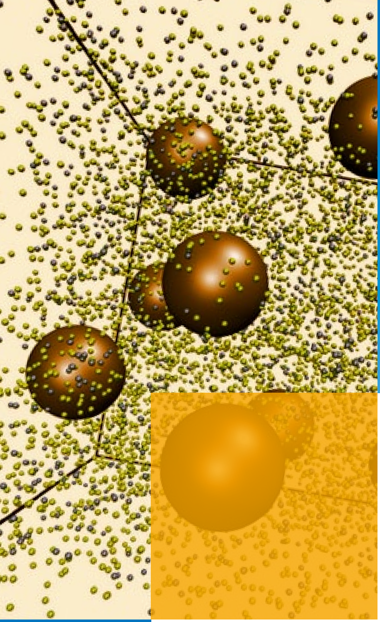

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Pause 15 minutes

TALK 2

Prof. David Le Touzé
Ecole Centrale Nantes, LHEEA Lab. (France)

SPH Modelling of fluid dynamics with complex interfaces

Despite their relatively recent application to fluid dynamics meshless Lagrangian methods are becoming an alternative to standard mesh-based methods in some situations of CFD. This is especially the case when complex interfaces are involved (free surfaces, fluid-structure or fluid-fluid interfaces). The sample results provided below illustrate situations where engineering applications can benefit from the specificities of such meshless Lagrangian numerical methods. The three practical examples provided as illustration are water-oil separation, flooding under an elastic dam, and tyre aquaplaning situations.

In general, these Lagrangian meshless methods are particularly well-suited to fast dynamics flows. These methods also provide interesting answers to some multi-physics/multi-mechanics issues, especially interfacial flows and fluid-structure interaction. The talk will start with giving the general principle of these methods and a brief review of mesh-free Lagrangian methods under current development.

It will then focus more particularly on the Smoothed Particle Hydrodynamics (SPH) method. The method principle and its numerical specificities will first be exposed. Then, its assets and drawbacks will be underlined, and the recent advances in its development will be discussed. Since there is a growing interest in this class of methods, it is now being applied to many fields of fluid dynamics. The talk will concentrate more specifically on interfacial hydrodynamics, and fluid-structure interaction.

[1] LE TOUZÉ D., COLAGROSSI A., COLICCHIO G., GRECO M., (2013), "A critical investigation of smoothed particle hydrodynamics applied to problems with free-surfaces", Int. J. Numer. Meth. Fluids 73, 660—691.
[2] MARRONE S., ANTUONO M., COLAGROSSI A., COLICCHIO G., LE TOUZÉ D., GRAZIANI G., (2011), "δSPH model for simulating violent impact flows", Comput. Methods Appl. Mech. Engrg. 200, 1526–1542.
[3] FOUREY G., LE TOUZÉ D., ALESSANDRINI B., (2011), "Three-dimensional validation of a SPH-FEM coupling method", Proc. 6th international SPHERIC workshop, Hamburg, Germany, June 8-10.
[4] GRENIER N., ANTUONO M., COLAGROSSI A., LE TOUZÉ D., ALESSANDRINI B., (2009), "An Hamiltonian SPH formulation for Interfacial and Free-Surface Flows using a Shepard Kernel", J. Comput. Phys. 228, 8380–8393.
[5] COLAGROSSI A., ANTUONO M., LE TOUZÉ D., (2009), "Theoretical considerations on the free-surface role in smoothed-particle-hydrodynamics", Physical Rev. E 79, 056701.