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SEMINAR ANNOUNCEMENT

Room Beltrami, Building 5, ground floor, Leonardo Campus
Department of Civil and Environmental Engineering

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"ABOUT DRY AND WET PARTICLES MULTI-SCALE MODELING"

Prof. Stefan Luding (University of Twente, Netherlands)

The dynamic behaviour of granular materials and powders is of considerable interest in a wide range of industries like chemical/mechanical engineering, or geotechnics. However, the full understanding or control of the different phenomena and mechanisms of the particle systems, natural phenomena, or processes is an essential challenge from both science and application perspectives.
The fundamentals can be studied by direct particle simulation methods, where often the fluid between the particles is important too, in order to gain a microscopic understanding of the processes and mechanisms. For large-scale applications, a micro-macro transition towards continuum theory is necessary, but only small element-tests can be modeled nowadays directly by discrete micro-scale methods. Thus, more and more often, meso-scale methods are used where the particles are up-scaled, representing a certain number of primary particles. As one example for such a meso-model, we use experiments and discrete particle simulations (DEM) to investigate the dosing of cohesive fine powders. Other applications involve chute flow or ring-shear rheology testing of wet granular flows as well as the study of the elastic, or elasto-plastic material behavior and the wave-propagation in saturated and unsaturated systems.
The micro-macro transition from discrete particulate systems to continuum theory involves a mathematical homogenization or coarse-graining that translates particle-positions, -velocities and -accelerations into density-, stress-, and strain-fields, by statistical spatial- and temporal averaging. The macroscopic fields are compatible with the conservation equations for mass and momentum of continuum theory, and also the fluctuating kinetic energy provides a measure for the importance of fluctuations in those systems. The ultimate goal is to find constitutive relations that contain information about the micro-structure and -fluctuations, and to solve those on the macro-level for solving application and optimization problems. Examples that can be considered are chute-flows down slopes, ring-shear testers as well as rotating drums, silos, or porous media, where the local rheology and transport/permeability models all should work, independent of the particular geometry, for a multitude of industrial or natural systems.

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Bio-sketch

Prof. Stefan Luding, studied physics at the University of Bayreuth, Germany, focusing on reactions on complex and fractal geometries. He continued his research in Freiburg for his PhD on simulations of dry granular materials in the group of Prof. A. Blumen. He spent his post-doctorate time in Paris IV, Jussieu, with E. Clement and J. Duran before he joined the computational physics group with Prof. Herrmann for his habilitation. In 2001, he moved to DelftChemTech at the TU Delft in Netherlands as associate professor for particle technology. Since 2007 he has held the chair on multi-scale mechanics (MSM) at the Faculty of Engineering Technology, CTW, at the University of Twente, Netherlands, with ongoing research on fluids, solids, particle interactions, granular materials, powders, asphalt, composites, bio- and micro-fluid systems and self-healing materials. Stefan Luding has been managing editor in chief of the journal Granular Matter since 1998. He has written more than 200 publications and is a member of several international working parties.