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Ernst Melan-Lectures

In October 2016, the Institute for Mechanics of Materials and Structures (IMWS), the Department of Civil Engineering, and the Center for Geometry and Computational Design at Vienna University of Technology have established a new Distinguished Lecture Series in the Engineering Sciences, named Ernst Melan-Lectures.

Ernst Melan (* 1890, in Brünn/Brno, † 1963, in Vienna) was a pioneer of engineering mechanics in the 1st half of the 20th century. As professor of elasticity theory, structural mechanics, and building construction at TU Wien from 1925 to 1962, he has sustainably shaped the culture of teaching and research at this university, where he has also held the positions of department head („Dekan“) and president („Rektor“). Among his numerous contributions to the engineering sciences, his shake-down theorem, as of 1936, and his general treatise of elastoplasticity, as of 1938, both anticipating many ideas which were hardly discussed before the 1950s, are true landmarks in the history of theoretical and applied mechanics.

We are pleased to announce that the Third Ernst Melan Lecture at TU Wien

will be given

by

Professor Gilles Pijaudier-Cabot
Laboratoire des fluides complexes et leurs réservoirs
Université de Pau et des Pays de l’Adour, Anglet, France

Prof. Pijaudier-Cabot will talk about

What can be expected from lattice modelling of quasi-brittle materials?

on

January 24th, 2024; 3:00 p.m.
Technische Universität Wien, Karlsplatz 13, 1040 Vienna
HS 13 Ernst Melan (7th Staircase, Second Floor)

What can be expected from lattice modelling of quasi-brittle materials?

Gilles Pijaudier-Cabot
Laboratoire des fluides complexes et leurs réservoirs
Université de Pau et des Pays de l'Adour
Anglet, France

Abstract:
Lattice modelling of quasi-brittle materials such as concrete is a discrete, mesoscale, description of the material in which constitutive relations are prescribed at a lower scale compared to the scale at which continuum-based constitutive relations are written usually. The meso-structure of the material is represented explicitly. Starting in the 1980's, this approach has become more and more popular, with two very different venues:

The first one stems from the physics of fracture in brittle disordered media. It relies on statistical analyses. The purpose is to inform continuum-based constitutive models on the nature of the variables that govern the mechanical deformation. Two examples related to damage and coupled hydromechanical effects are outlined.

The second venue started with the pioneering works of Cundall, Bazant and Zubelewicz, and Van Mier in the 80's. The mesoscale description of the material allows for upscaling. Complex nonlinear responses at the macroscale are obtained, while keeping the constitutive model at the mesoscale simple and less phenomenological compared to macroscale ones. Over the years, such lattice models have become more and more efficient. In this lecture, we shall provide some examples dealing with the prediction of structural size effect or hydraulic fracturing. These models can also capture the complexity of the fracture process, as observed in experiments.

The superior capability of lattice approaches has a price: extensive computational cost in structural analyses. Nevertheless, it can be expected that such models will be helpful to produce high-fidelity databases that could be readily used in modern data-driven or coarse-grained approaches. This lecture concludes with recent results on coarse graining of results from the lattice discrete particle model, allowing to reflect upon existing, nonlocal, macroscale models of failure.

Gilles Pijaudier-Cabot

Gilles Pijaudier-Cabot graduated from Ecole Normale Supérieure de Cachan and obtained a doctoral degree from université Pierre et Marie Curie in 1985 and a Ph.D. from Northwestern University in 1987. He joined CNRS in 1988 and later on the faculty of civil engineering of Ecole Normale Supérieure de Cachan (ENSC) in 1992 as a full professor. At ENSC, he developed computational tools for evaluating the integrity of concrete structures. In 1999, he joined Ecole Centrale de Nantes and created with the help of Electricité de France, VM Matériaux and Lafarge, the Failure and Durability group, jointly operated with industry. In 2007, Gilles Pijaudier-Cabot moved to Université de Pau et des Pays de l'Adour (UPPA) and directed the joint laboratory with CNRS and TOTAL on complex fluids, geomechanics and geology. At UPPA, he has been in charge of the excellence initiative of the university since 2017, serving today as a vice-rector.

His research activities dealt first with damage mechanics. It was during his PhD with Prof. Z.P. Bažant that the non-local damage theory was coined, bridging the gap between continuum mechanics and fracture mechanics in solid materials. Later on, he turned toward studies on the physical aspects of fracture and durability mechanics, combining damage mechanics with chemistry of cement. Starting in 2004, he focused interest on the permeation properties of concrete and rocks undergoing mechanical loads, with applications to waste storage, safety of nuclear vessels, and hydraulic fracturing for unconventional hydrocarbon production. He created in 2008 a group dedicated to hydro-mechanics of porous materials, including lattice approaches for failure, analytical models for estimating multi-phase fluid flow properties in rocks and coupled adsorption and swelling phenomena in micro-porous materials.

Gilles Pijaudier-Cabot authored over 100 papers in international journals. He received the bronze medal from CNRS in 1991 and the Jean Mandel prize of the French association of mechanics in 1992. He has been a member of Institut Universitaire de France (IUF) since 1996. He obtained an ERC advanced grant in 2008 and received the Dolomieu Grand Prix from the French Academy of Sciences in 2019.

Member of ASCE-EMD, and now EMI, Gilles Pijaudier-Cabot has been the first foreign chair of a technical committee of ASCE in 1997. He served as chairman of many committees at the national level, and chaired the French national committee evaluating research on radioactive materials and wastes for the past three years.