



Laboratoire de Mécanique des Solides
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Parrainé par la Chaire André Citroën



Symposium Jean Mandel

*Computational Methods in
Mechanics*

Méthodes numériques en mécanique

Friday, June 17th, 2022

Gay-Lussac Amphitheatre
École Polytechnique

Free and mandatory registration at
<https://evento.renater.fr/survey/symposium-jean-mandel-june-17th-zftyzsto>
before June 12th, 2022
Contact : laurent.guin@polytechnique.edu

Plenary Lecture

by Barbara Wohlmuth

Mathematical aspects of Computational Science and Engineering

In this talk, we address several aspects and challenges of PDE simulations. A high-resolution finite element simulation is typically expensive due to, e.g., complex geometries, anisotropic material laws or large spatial and temporal scales. A variety of different examples ranging from reduced basis approaches, dimension reduction techniques, the use of surrogate operators to variational inequalities and non-local operators defined by convolutions will be discussed. We provide a brief glimpse into the mathematical abstract framework but the focus is on different applications. We also give a brief introduction into the world of large-scale simulations based on hybrid discretization and solver techniques. On current supercomputing systems, highly scalable implementations execute hundreds of thousands parallel threads on millions of compute nodes. Thus, it may become essential that fast matrix free approaches, uncertainty in the data and fault tolerance solvers are supported algorithmically. Although classical element based assembling routines are of optimal complexity, they are not necessarily optimal with respect to run-time. Here we propose surrogate stencil strategies based on two-scale approximation and scaling.

Barbara Wohlmuth

Professor of Numerical Analysis
Department of Mathematics
Technical University of Munich



Professor Wohlmuth studied mathematics at TUM and at Grenoble. She also received her doctorate from TUM (1995) and completed her postdoctoral teaching qualification at the University of Augsburg. Various positions as visiting scientist or professor led her to the US, to France, Hong Kong and Norway. In 2001, she was appointed to her first chair position at the University of Stuttgart, followed by from TU Darmstadt, FU Berlin and later on from UT Austin and EPFL (Lausanne). In 2010, Professor Wohlmuth joined the faculty of TUM. She serves on academic boards of highly renowned institutions in the US and Europe, and on several Editorial boards of international journals. She is a SIAM fellow and elected member of the Bavarian Academy of Sciences, the Leopoldina and the European Academy of Sciences. As Director of the International Graduate

School of Science and Engineering at TUM she promotes new paths for training young scientists in an international, intersectorial and interdisciplinary environment. The research of Barbara Wohlmuth examines the numerical simulation of partial differential equations. Special areas of interest are discretization techniques, multi-scale solvers, coupled multi-field problems and predictive modelling. Interdisciplinary cooperation with engineering experts is an important part of her work.

Friday, June 17th, 2022 Program

Gay-Lussac Amphitheater

- 08:30 - 08:55 am *Registration and Welcome Coffee*
- 08:55 - 09:00 am **Welcome Address** by **Andrei Constantinescu**, LMS director
- 09:00 - 10:00 am **Plenary Lecture** by **Barbara Wohlmuth**
Mathematical aspects of computational science and engineering
- 10:00 - 10:20 am *Coffee Break*
- 10:20 - 10:40 am **Jessica Mangano** and **François Kimmig**
Energy preserving reduced-order cardiovascular models for augmented hemodynamics monitoring
- 10:40 - 11:00 am **Jérôme Diaz**
Fluid-structure interaction and autocontact with an immersed thin solid: application to the aortic valve
- 11:00 - 11:20 am **Bertrand Leturcq**
A new class of model order reduction based on nonuniform transformation field analysis (NTFA)
- 11:20 - 11:40 pm **Mahdi Manoochehrtayebi**
Effect of microscopic properties on the homogenized linear poroelastic behavior of the lung parenchyma
- 11:40 - 12:00 pm **Laurane Preumont**
Extended one-dimensional model for efficient mechanical computation in directed energy deposition additive manufacturing
- 12:00 - 14:00 pm *Lunch on the lake shore*
- 14:00 - 14:20 pm **Zahra Hooshmand**
Mechanically-grown morphogenesis of Voronoi-type materials: computer design, 3D printing, and experiments
- 14:20 - 14:40 pm **Haoming Luo**
Simulation of a nonlinear matrix filled with particles using the mesh-to-mesh solution mapping method.
- 14:40 - 15:00 pm **Geoffrey Magda**
On electromagnetic forces in ferromagnetic wire conductors subjected to electric currents and external magnetic fields
- 15:00 - 15:20 pm *Coffee Break*
- 15:20 - 15:40 pm **Emilien Baroux**
Statistical analysis of usage for the reliable design of automotive structures
- 15:40 - 16:00 pm **Nikhil Mohanan**
A thermo-elasto-viscoplastic finite-element (T-EVP-FE) model to study polycrystal evolution under thermo-mechanical loading
- 16:00 - 16:20 pm **Arnaud Coq**
Experimental characterization and modeling of the fracture of a thermoplastic polymer
- 16:20 - 16:30 pm *Final Discussion*

Jean Mandel

Founder of the Laboratoire de Mécanique des Solides



After brilliant secondary studies, Jean Mandel went on to École Polytechnique in 1927 and later to École des Mines. In 1932 he became a professor at École des Mines de Saint-Étienne and in 1948 at École des Mines de Paris. From 1951 to 1973 he was professor of mechanics at École Polytechnique.

Jean Mandel's research career was devoted mainly to the mechanics of solids and the strength of materials. In 1961 he created the Laboratoire de Mécanique des Solides, a laboratory common to École Polytechnique, École des Mines de Paris, École des Ponts et Chaussées and associated to the Centre National de la Recherche Scientifique. In October 1964 he founded and became the first president of the Groupe Français de Rhéologie. In 1980 he became "honorary member" of this group.

The scientific work of Jean Mandel covers a very wide field with a bibliography listing more than 150 articles and 5 books. He presented original ideas on the buckling of beams and shells, the finite deformations of solids, laminar flow in porous media, the bearing capacity of shallow foundations, the punch resistance of a two-layer medium, the stability of underground cavities, the plastic flow of metals, and the effect of cyclic loading on structures, as well as contributions to the fields of thermodynamics, rolling friction and homogenization.

But Jean Mandel's influence extended far beyond the field of his personal research. A good many students were trained, under his direction, in the Laboratoire de Mécanique des Solides. A fine teacher and a constant stimulus to his research group, he gave his time generously to study the details of manuscripts that were sent to him and to suggest the minor modifications he deemed necessary. Those who had the privilege of working with him were left with an impression of palpable scientific passion and moral rigor that will continue to be an example for generations to come.

Jean Mandel passed away on the 19th of July 1982, the victim of a tragic accident at the very height of his intellectual prime.

Text by Pierre Habib

The Jean Mandel Symposium is open to all students, researchers and scientists interested in the proposed topic. It combines, in an informal setting, a keynote presentation by an internationally renowned scientist and talks given by young researchers associated with the laboratory.