Programme des Leçons Jacques-Louis Lions 2018 données par Annalisa Buffa du 21 au 23 novembre 2018

La quatrième édition des Leçons Jacques-Louis Lions aura lieu du 21 au 23 novembre 2018.

Données par Annalisa Buffa (Ecole Polytechnique Fédérale de Lausanne), les Leçons Jacques-Louis Lions 2018 comprendront :

– **un mini-cours**
The interplay of geometric modelling and numerical analysis of PDEs
mercredi 21, jeudi 22 et vendredi 23 novembre 2018, de 11h00 à 12h30,
salle du séminaire du Laboratoire Jacques-Louis Lions,
barre 15-16, 3ème étage, salle 09 (15-16-309),
Sorbonne Université, Campus Jussieu, 4 place Jussieu, Paris 5ème,

– **et un colloquium**
New trends in finite element theory : the isogeometric method
vendredi 23 novembre 2018 de 14h00 à 15h00,
même salle.

Résumé du mini-cours
The interplay of geometric modelling and numerical analysis of PDEs

Over the last fifty years, computer simulations have dramatically increased their impact on research, design and production, and are now an indispensable tool for development and innovation in science and technology. Partial Differential Equations (PDEs) offer a broad and flexible framework for modelling and analysing a number of phenomena arising in fields as diverse as physics, engineering, biology, and medicine. Not surprisingly, research on methods to simulate PDEs have a central role in modern science.

In reality, the simulation of PDEs is a brick within a workflow where, at the beginning, the geometrical entities are created, described and manipulated with a geometry processor, often through Computer-Aided Design systems (CAD), and then used as input in Computer-Aided Engineering systems (CAE) where they are handled and processed for the simulation. The representation of geometric entities has its roots in geometric modelling, and often the requirements of shape design are different from those of simulation, which is based on numerical methods for PDEs. The simulation of PDEs on CAD geometries (which are mainly represented through their boundaries) calls then for (re-)meshing and re-interpolation techniques that are computationally expensive and result in non-exact geometries as well as inaccurate solutions.

In this course, I will give an introduction to the recent scientific efforts devoted to tackle this bottleneck both from the perspective of geometric modelling and of the numerical analysis of PDEs. From volumetric modelling to the framework of isogeometric analysis, within a mathematical perspective, I will provide an overview of the state of the art and of the many questions that are still open.

Résumé du colloquium
New trends in finite element theory : the isogeometric method

Numerical methods for partial differential equations (PDEs) is a branch of numerical analysis which offers scientific challenges spanning from functional analysis to computer science and code design. The discretisation of differential problems beyond the elliptic case and in the non linear context often requires special choices of discretisation spaces, and robust discretisations are the result of a deep understanding of the mathematical structures of the problem to solve.

In the last ten years the use of splines as a tool for the discretisation of partial differential equations has gained interest thanks to the advent of isogeometric analysis. For this class of methods, all robust and accurate techniques aiming at enhancing the flexibility of splines, while keeping their structure, are of paramount importance since the tensor product structure underlying spline constructions is far too restrictive in the context of approximation of partial differential equations.

I will describe various approaches, from adaptivity with regular splines to patch gluing and to trimming. Moreover, I will show applications and test benches in (non linear) mechanics, such as large deformation problems with contact and quasi-incompressible materials.