LBMC UMR_T 9406, IFSTTAR-UCBL
Site IFSTTAR Lyon-Bron
25, avenue François Mitterrand
69675 BRON Cedex

http://www.lbmc.ifsttar.fr/

SEMINAIRE SCIENTIFIQUE – ECOLE DOCTORALE MEGA
Jeudi 14 Septembre 2017 à 15h00
IFSTTAR - Salle Leonard de Vinci
Cité des Mobilités - Bron

Titre : Ondes élastiques dans les tissus mous

Michel DESTRADE, School of Mathematics, Statistics and Applied Mathematics, NUI Galway, Ireland

Résumé **:**
Etudier et modéliser mathématiquement des tissus mous biologiques ou des gels est une tâche complexe. Souvent, ces tissus sont traités comme des matériaux d'ingénierie. Les bio-ingénieurs tentent d'évaluer les propriétés mécaniques de ces tissus en se basant sur des protocoles expérimentaux normalisés: tests en traction, cisaillement pur, torsion... Ces essais ont lieu dans un laboratoire où l'échantillon est prélevé sur cadavre, puis monté sur une machine de test. Mais les propriétés mécaniques des tissus vivants sont très sensibles à leur environnement et les protocoles de tests destructifs donnent seulement une indication approximative de leur ordre de grandeur.

D'un autre côté, l'étude de la propagation des ondes élastiques procure une méthode permettant de tester les tissus mous de manière non destructive et non invasive. A l'instar d'un accordeur de piano qui récupère de l'information en jouant d'une corde tout en modifiant sa tension, nous pouvons étudier l'influence de la précontrainte sur la vitesse des ondes élastiques se propageant dans un solide mou. Cette idée est à la base de la théorie acousto-élastique, qui remonte aux premiers travaux de Brillouin et qui a été utilisée avec succès par le passé pour des solides élastiques "durs" tels que les roches ou les métaux.

Au cours de cet exposé, nous explorerons le développement de l'acousto-élasticité pour les solides élastiques "mous", qui peuvent être facilement soumis à de grandes déformations en pratique. Nous présenterons des résultats théoriques, numériques, et expérimentaux, avec des applications cliniques, obtenus sur des gels, le cerveau, le sein ou encore la peau.

Biography **:**
Michel Destrade is the Chair of Applied Mathematics at NUI Galway, and Adjunct Professor of Mechanical Engineering at University College Dublin, Ireland. Previously, he worked as a Marie Curie Fellow (FP4 & FP7) at University College Dublin; as a Visiting Assistant Professor at Texas A&M University; and as a Chargé de Recherche at the Institut D'Alembert, Université Pierre et Marie Curie.

His research interests are in nonlinear elasticity, in stability of elastomers and biological soft tissues, and in linear, linearized, and non-linear waves. In those fields, he has co- authored 3 invited book chapters and 110 publications in refereed international journals. He is currently Reviews Editor for Proceedings of the Royal Society A and Contributing Editor in Solid Mechanics for International Journal of Non-Linear Mechanics. His research has been supported by several competitive grants awarded, among others, by the European Commission; Royal Society; British Council; Agence Nationale pour la Recherche; CNRS; Science Foundation Ireland; Enterprise Ireland and the Irish Research Council.

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Title: Elastic waves in soft tissues

Michel DESTRADE, School of Mathematics, Statistics and Applied Mathematics, NUI Galway, Ireland

***Abstract*:**
Biological soft tissues and soft gels are difficult to study and model mathematically. Bioengineers often see tissues as engineering materials and try to evaluate their mechanical properties by relying on standard testing protocols, such as tensile testing, simple shear, torsion, etc. These processes take place in the laboratory, where a sample is cut out of a cadaver and placed into a testing machine. But the mechanical properties of living tissues are highly sensitive to their environment and the destructive testing protocols only give a rough indication of their order of magnitude.

To test soft tissues properly, non-destructively, and non-invasively, we can rely on the propagation of elastic waves. Just like a piano tuner can infer some information simply by tapping a cord while changing its state of stress, we can study the influence of pre-stress on the speed of elastic waves travelling in a soft solid. This idea forms the basis of the theory of acousto-elasticity, which can be dated back to early works of Brillouin, and has been used successfully in the past for "hard" elastic solids such as rocks and metals.

With this talk we will explore the extension of acousto-elasticity to "soft" elastic solids, which can be subjected to large deformations in service. We will look at theoretical, numerical, experimental, and even clinical results, generated in particular on gels, brain, breast, and skin.

Biography :
Michel Destrade is the Chair of Applied Mathematics at NUI Galway, and Adjunct Professor of Mechanical Engineering at University College Dublin, Ireland. Previously, he worked as a Marie Curie Fellow (FP4 & FP7) at University College Dublin; as a Visiting Assistant Professor at Texas A&M University; and as a Chargé de Recherche at the Institut D'Alembert, Université Pierre et Marie Curie.

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