Elastography for muscle biomechanics (2h)

Abstract
The aim of this session is to present elastography techniques and the use of the supersonic shear imaging technique for muscle studies with application to sports. 35 min will be dedicated to demo in real time to illustrate the presentations and questions from the audience.

This session is sponsored by the Supersonic Imaging company.

1- Presentation of elastography methods and Supersonic Shear Imaging (Jean-Luc Gennisson, 25 min)

Abstract – Shear wave ultrasound elastography is an emerging technique that allows to estimate tissue mechanical properties. In the case of muscles, these techniques must be adapted in order to estimate multiple parameters such as stiffness, viscosity or anisotropy, in a large field of view and moreover in real time to follow muscle contraction. In this presentation an overview on elastography methods is presented and the supersonic shear imaging technique is specifically described in details in order to achieve these goals.

Jean-Luc Gennisson was born in 1974 in France. He received the D.E.A. degree in Electronics in 2000 from the University of Paris VI. In 2003, he received the Ph.D. degree in physics (acoustics) from the University of Paris VI for his work on transient elastography. From 2003 to 2005, he worked at the laboratory of biorheology and medical ultrasound in Montreal, Canada, for postdoctoral research with Pr. Guy Cloutier. In 2005, he became a research scientist of the French national research center (CNRS). He is currently working at the Langevin Institute directed by Pr. Arnaud Tourin. His current research interests include medical ultrasonic imaging, shear wave propagation in soft tissues for cancer diagnosis so-called "shear wave elastography", shear viscosity and nonlinear shear waves.

2- Muscle elastography during contraction: new insights into adaptation of muscle coordination to fatigue, pain (François Hug, 25 min)

Abstract – Recent experiments demonstrated that measurement of muscle stiffness using elastography can be used to estimate changes in muscle force during isometric contractions. This presentation will present a series of experiments that took advantage of this method to provide a deeper understanding of motor adaptations during experimental pain and neuromuscular fatigue.

François HUG (PhD) is a Principal Research Fellow in the NHMRC Centre of Clinical Research Excellence in Spinal Pain, Injury and Health (CCRE SPINE), at the University of Queensland (Australia). He has a background in Human Movement Sciences (PhD in 2003 at the University of Aix-Marseille II, France). After a post-doctoral period at the University of Paris VI, he was employed as research fellow at the French National Institute of Sports (France). He continued his research at the University of Nantes (France) from 2006 to 2012. Particular research interests lie within the areas of muscle coordination and muscle biomechanics. Taking advantage of elastography to estimate individual muscle force, his recent works aim to understand motor adaptations during experimental pain and muscle fatigue. François has published over 85 peer-reviewed articles in the fields of muscle biomechanics and neurophysiology. He serves on the editorial board of *Journal of Electromyography and Kinesiology* and as an academic editor for *PloS ONE*.

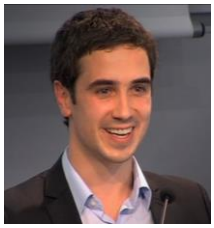
3- Passive muscle elastography: toward a better understanding of the effects of stretching (Antoine Nordez, 20 min)

Abstract – Recent work from our team demonstrated that elastography can be used to estimate passive muscle force during stretching. This talk will present a series of experiment that aims to to measure localized effects of stretching using elastography in order to provide a better understanding of stretching effects and factors that influence the maximal range of motion at a joint.

Antoine Nordez is an associate professor at the University of Nantes. He has a background in mechanical engineering (Msc in 2003 at the Ecole Centrale de Nantes) and biomechanics (PhD in 2006 at the University of Nantes, France). After a post-doctoral period at the Biomechanics Lab (2006-2007, Arts et Metiers ParisTech), he continued his research at the University of Nantes (France) from 2008. His research interests lie within the areas of muscle biomechanics. Antoine has published over 52 peer-reviewed articles in this field. With his team, he was a pioneer in the use of elastography to study muscle biomechanics in vivo.

4- Elastography to study the effects of muscle damage (Gaël Guilhem, 15 min)

Abstract - Changes in muscle stiffness after exercise-induced muscle damage have been classically inferred from passive torque measured at the joint level. This presentation will address the changes in the shear elastic modulus and the dissipative properties induced by eccentric exercise in the damaged muscle, and their relationship with functional impairments.



Gaël Guilhem is in charge of the coordination of research projects dealing with "Neuromuscular function and sport gesture" at the Research Department of the French National Institute of Sport (INSEP) since 2009. Author of several peer-reviewed publications, he also serves as a reviewer for 15 international journals. His research focuses on neuromuscular adaptations to acute and chronic exercise using EMG, MRI, ultrasonography and elastography. He is also involved in expertise projects with several sport federations and currently investigating performance enhancement induced by various resistance modalities.