



Short Course on October 7, 2012

Title: **Ultrafast Ultrasound Imaging: Principles and Applications**

Instructors: **Mathias Fink, Mickaël Tanter**, Langevin Institute, ESPCI ParisTech

Course Description

The advent of ultrafast ultrasonic scanners is today paving the way to tremendous applications in medical ultrasound. This course will present the basic principles of Ultrafast Imaging (plane wave imaging, synthetic aperture imaging, parallel receive beamforming, plane wave compounding, etc.) and their implications in terms of resolution, contrast and frame rates. It will also explain the analogy of this concept with optical holography. For our purposes, theoretical aspects and experimental validations will be highlighted. The course will also emphasize technological issues and system architecture constraints. Far beyond breaking technological barriers, the concept of ultrafast imaging is currently changing the paradigm of ultrasound imaging. The course will illustrate how this concept leads to breakthrough innovations in the field by revisiting Bmode, Doppler, tissue strain and nonlinear imaging. Many examples (Shear Wave Imaging, Ultrafast Doppler, Ultrasensitive Doppler, Ultrafast Contrast Imaging, etc.) will illustrate the potential of this new concept and technology.

Mathias Fink received his M.S. degree in mathematics from Paris University, France, in 1967 and a Ph.D. degree in solid state physics in 1970. He then moved on to medical imaging and received a Doctorates-Sciences degree in 1978 from Paris University. His Doctorates-Sciences research was in the area of ultrasonic focusing with transducer arrays for real-time medical imaging. Mathias Fink is a professor of physics at the Ecole Supérieure de Physique et de Chimie Industrielles de la Ville de Paris (ESPCI ParisTech), Paris, France. In 1990 he founded the Laboratory OndesetAcoustique at ESPCI that became in 2009 the Langevin Institute. In 2002, he was elected at the French Academy of Engineering, in 2003 at the French Academy of Science and in 2008 at the Collège de France as Chair of Technological Innovation. Mathias Fink's area of research is concerned with the propagation of waves in complex media and the development of numerous instruments based on this basic research. His current research interests include time-reversal in physics, super-resolution, metamaterials, medical ultrasonic imaging, ultrasonic therapy, ultrafast imaging, multiwave imaging, acoustic smart objects, acoustic tactile screens, underwater acoustics, geophysics and telecommunications. He has developed different techniques in medical imaging (ultrafast ultrasonic imaging, transient elastography, supersonic shear imaging), wave control and focusing in complex media with time-reversal mirrors. He holds more than 55 patents and he has published more than 350 peer reviewed papers and book chapters. 4 start-up companies have been created from his research (Echosens, Sensitive Object, Supersonic Imagine and Time Reversal Communications)

Mickaël Tanter, Ph.D., is a Research Professor at the French National Institute for Health and Medical Research (INSERM). For five years, he has been heading the team Inserm ERL U979 "Wave Physics for Medicine" at Langevin Institute, ESPCI ParisTech, France. In 1999 he was awarded his Ph.D. degree from Paris VII University in Physics. His main activities are centered around the development of new approaches in wave physics for medical imaging and therapy. His current research interests are a wide range of topics: Elastography using Shear Wave imaging, High Intensity Focused Ultrasound, Ultrasonic imaging using ultrafast ultrasound scanners, adaptive beamforming, and combination of Ultrasound with optics and MRI. Mickael Tanter is the recipient of 17 patents in the field of ultrasound imaging and the author of more than 120 peer reviewed papers and book chapters. He is Associate Editor and TPC member of IEEE Ultrasonics and member of the Brain Advisory board of the Focused Ultrasound Surgery Foundation. In 2005, he, along with M. Fink, J. Souquet, C. Cohen-Bacrie and J. Bercoff founded Supersonic Imagine, an innovative French company positioned in the field of medical ultrasound imaging and therapy, that in 2009 launched a new-generation Ultrasound imaging platform called Aixplorer™ with a unique shear wave imaging modality. In 2009, he received the Frederic Lizzi Early Career Award of the International Society of Therapeutic Ultrasound and the Montgolfier Prize of the National Society for Industry valorization (S.E.I.N.) in 2010. In 2012, he received the Grand Prize of Medicine -Jean Hamburger- of Paris city.

Conference website: http://ewh.ieee.org/conf/ius_2012

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