



## Short Course on October 7, 2012

Title: **Multiscale Acoustic Imaging – From Quantitative In-Vivo Ultrasound to Scanning Acoustic Microscopy of Biological Tissues**

Instructors: **Naohiro Hozumi**, Toyohashi University of Technology, **Roman Maev**, Institute for Diagnostic Imaging Research, University of Windsor, **Kay Raum**, Julius Wolff Institute, Charité-Universitätsmedizin Berlin, **Yoshifumi Saijo**, Tohoku University

### **Course Description**

Several high frequency ultrasound techniques have been developed during the last decade with the intention to assess elastic properties of soft and hard biological tissues and cells. The basic measurement principles can be divided into transmission and reflection, backscatter measurements or the evaluation of surface acoustic wave velocities. This course will be divided into three sections:

The first part covers the physical principles and technological developments, including recent custom developments and commercial products (Q-BAM, Honda, Kibero).

The second part will focus on quantitative multi-scale imaging elastic properties of hard tissues and their applications in bone research (e.g. elastic phenotyping, healing, and numerical modeling).

In the last part, several technologies for soft tissue and cell characterization, including ultrasound based histology and tissue grading, as well as acoustic live cell imaging will be demonstrated.

**Naohiro Hozumi** was born in Kyoto, Japan on April 2, 1957. He received his B.S., M.S. and Ph.D. degrees in 1981, 1983 and 1990 from Waseda University. He was engaged in Central Research Institute of Electric Power Industry (CRIEPI) from 1983 to 1999. He was an associate professor of Toyohashi University of Technology from 1999 to 2006, and a professor of Aichi Institute of Technology from 2006 to 2011. Since 2011, he has been a professor at the Toyohashi University of Technology. He has been engaged in the research of insulating materials and diagnosis for high voltage equipment, acoustic measurement for biological and medical applications, etc. He received awards from IEE Japan for his outstanding research papers in 1990 and 1999. He is a member of IEEE, IEE Japan and the Acoustic Society of Japan.

**Roman Gr. Maev** is the founding Director-General of The Institute for Diagnostic Imaging Research - a multi-disciplinary, collaborative research and innovation consortium. The Institute was formed in 2008 by the Ontario Ministry of Research and Innovation. Dr. Maev holds the title of University Professor, Distinguished in the Department of Physics at the University of Windsor, Canada. In 2002 Dr. Maev became the DaimlerChrysler/NSERC Industrial Research Chair and in 2008 the Fiat/Chrysler/NSERC Industrial Research Chair in Advanced Materials Characterization. In 2004, a new initiative by Chrysler, "Tessonics Corporation" was created with its main mission for the commercialization of the research products developed by Maev's R&D team at the University of Windsor. Dr. Maev was one of the founders of Tessonics. Tessonics submitted a proposal in the field of Nanotechnology for the Rusnano fund for a total of \$23 million dollars with the topic: Hydroxyapatite Nanostructured (Nanocrystalline) Implant Coatings. Dr. Maev is the author of 4 monographs, editor and co-editor of 9 books, has published over 380 articles in leading international journals, and holds 25 international patents. Dr. Maev, was appointed as an Adjunct Professor in Oxford University (UK), Johns Hopkins University (Baltimore, USA), McGill University (Montreal, Canada), University of Michigan, (Ann Arbor USA) as well as being a member of the Brockhouse Materials Research Institute, (McMaster University (Canada). Currently serving as a member of the Editorial Advisory Board of the Journal of Research in Nondestructive Evaluation and served as an associate editor of IEEE Transaction in Ultrasonics, Ferroelectrics and Frequency Control. He is involved in and

served on organizing committees of various prestigious international conferences. Roman Gr. Maev was born in Russia, and received his Master of Science degree in Theoretical Nuclear Physics from the Moscow Physical Engineering Institute followed by a Ph.D. on the Theory of Semiconductors from the Physical P.N. Lebedev Institute of the USSR.

**Kay Raum** graduated from the Martin Luther University of Halle-Wittenberg with a diploma and Ph.D. degree in Physics in 1997 and 2002, respectively. From 1995-1996 he was with the Bioacoustics Research Laboratory at the University of Illinois at Urbana-Champaign as a Visiting Scholar. From 1997 until 2003 he was a research assistant at the Medical Faculty of the Martin Luther University. In 2004 he received a post-doctoral fellowship from the French National Center of Scientific Research (CNRS) and joined the Laboratoire d'Imagerie Paramétrique at University Pierre et Marie Curie, Paris, France. In 2006 he became the Research Head of the Interdisciplinary Center for Musculoskeletal Diseases and in 2008 he received his Habilitation in "Experimental Orthopedics" at the Medical Faculty of the Martin Luther University. In 2008 he received his Habilitation in "Experimental Orthopedics" at the same faculty. Since 2008 he has been a Professor of Engineering, Berlin-Brandenburg Graduate School for Regenerative Therapies (DFG GSC 203), and Head of the Ultrasound Biomicroscopy group of the Julius Wolff Institute at Charité-Universitätsmedizin Berlin. He is the German coordinator of the European Associated Laboratory "Ultrasound Based Assessment of Bone". He is a member of the IEEE, the IEEE Ultrasonics Society, and the VDE. He has been working with high frequency ultrasound for more than 15 years, and he has contributed specifically to the establishment and validation of quantitative acoustic microscopy in bone research. His current research is focused on the development of innovative parametric imaging techniques and their application in musculoskeletal research.

**Yoshifumi Saijo** was born in Yokohama, Japan on July 21, 1962. He received M.D. and Ph.D. degrees in 1988 and 1993 from Tohoku University. He is currently a Professor of Biomedical Imaging Laboratory at the Graduate School of Biomedical Engineering of Tohoku University. He is concurrently engaged with the Graduate School of Medical Sciences, School of Engineering, Institute of Development, Aging and Cancer of Tohoku University and the Department of Cardiovascular Surgery of Tohoku University Hospital. His main research interests are high frequency ultrasonic imaging of biological tissues and cells, parametric imaging of intravascular ultrasound, blood flow dynamics imaging by echocardiography and MRI, photoacoustic imaging of biological tissues and mobile ultrasonic imaging by developing portable ultrasound devices. He was awarded in 1997 for his outstanding research paper in Ultrasound in Medicine and Biology. He is a member of the Japan Society of Ultrasonics in Medicine, Japanese Society of Echocardiography and Japan Circulation Society.

Conference website: [http://ewh.ieee.org/conf/ius\\_2012](http://ewh.ieee.org/conf/ius_2012)

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