Short Course on October 7, 2012

Title: **Tissue Motion Assessment and Biomechanical Property Imaging Update**

Instructor: **Jeffrey C. Bamber**, Ultrasound and Optical Imaging Team, Joint Department of Physics, Institute of Cancer Research and Royal Marsden Hospital, and **Leo Garcia**, Velindre Cancer Centre, Cardiff, Wales, UK

Course Description

Backscatter ultrasound imaging has a unique ability to measure and image deep tissue displacements and deformations for long periods, with very high temporal and spatial resolution, and with low probability of harmful effect to the subject. This course will review the techniques that have been employed to achieve this, and describe their relative merits and limitations, including the options available for three dimensional displacement and deformation estimation. It will then examine the areas to which this capability has been applied, which include (a) biomechanical property measurement and imaging, also known as elastography, (b) motion compensation for improved radiotherapy and high intensity focused ultrasound treatments, (c) motion compensation for improved alternative imaging, such as magnetic resonance images, and (d) clutter reduction in backscatter ultrasound and photoacoustic images. Biomechanical property imaging will feature strongly in the course, covering the various ways in which the measured time varying displacement or deformation may be viewed directly as a qualitative image, with useful biomechanical property contrast, or may undergo further processing to reconstruct quantitative images. Consideration will be given to methods for imaging and measuring tissue properties related to shear storage modulus, loss modulus, frequency dispersion, compressibility, non-linearity, anisotropy, porosity, permeability, and mechanical continuity. The many sources and types of stress that have been employed will be discussed, including hand-induced motion at the surface of the body, impulsive acoustic radiation force deep within it, harmonic vibrations, and natural (cardiovascular) sources of motion. The differences and similarities between the main commercial elastography systems will be highlighted, and they will be assessed in the context of techniques developed in research laboratories. The ultrasound system architectures necessary for each approach will also be considered and example clinical application areas will be described.

Jeffrey C. Bamber is head of the Ultrasound and Optics Physics Team and Senior Tutor at The Institute of Cancer Research, Sutton, U.K. He has an honorary position as a Medical Physicist within the Royal Marsden Hospital, Sutton. He received a BSc in Physics from the University of Kent at Canterbury in 1972, an MSc in Biophysics and Bioengineering from the University of London in 1974, and a Ph.D. in Biophysics in 1980, also from the University London. He continued as a research scientist following his Ph.D. at the Institute of Cancer Research, becoming a team leader in 1986. He has had two sabbaticals, in 1994-1995 with the Medical Products Group, Hewlett-Packard, Andover, MA, USA, and briefly in 1993 at Toyo Institute of Technology. His research interests have included: acoustic characteristics of tissues, ultrasound image speckle and texture, speckle reduction, ultrasound aberration, psychophysics of perception of information in ultrasound images and movies, ultrasonic methods in breast cancer, measurement of tumour volume and blood flow, ultrasound tissue motion tracking, tissue biomechanical property imaging, temperature imaging, high frequency ultrasonic imaging and tissue characterization, ultrasound and optical methods in skin cancer, microbubble contrast agents, ultrasound guidance of focused ultrasound therapy and radiotherapy, ultrasound in radiation dosimetry, microbubbles as gene therapy vectors, photoacoustic imaging and molecular imaging. Awards for work to which he has contributed include 7 for best/selected journal papers and 2 for book publishing excellence. He is a past vice-president of the International Society for Skin Imaging, a past president of the International Association for Breast Ultrasound, and currently serves on the Science and Education Committee of the British Medical Ultrasound Society.

Leo Garcia is currently a trainee medical physicist at Velindre Cancer Centre in Cardiff, Wales, UK. He received his BSc in Physics with Medical Physics from the University of Wales, Swansea in 2006, an MSc in Radiation Physics with Medical Applications from the University College London in 2007, and a PhD in ultrasound physics from the Institute of Cancer Research in Surrey in 2011. He remained at the Institute of Cancer Research until September 2012 as a postdoctoral research scientist. Dr Garcia's research interests have included ultrasound elastography and ultrasound tissue motion tracking for guided radiotherapy.

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

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