Ultrasound – Provisional Lecture Synopses

Physical Principles of Ultrasound
Lecturer: Prof Jeff Bamber

Linear and non-linear propagation of ultrasound waves, acoustic characteristics of biological media and contrast agents, interactions of ultrasound with tissue, moving scatterers, relevance to image formation, limitations for imaging the human body.

Acoustic radiation fields: Methods of computing and measuring / observing acoustic radiation fields, diffraction loss, effects of focusing, comparison of continuous wave with pulsed excitation, resolution, effects of attenuation, mathematics and principles of echo image formation, relationship to other imaging modalities, speckle and other forms of noise, speckle reduction, effects of non-linear propagation and other effects of the propagation medium, basis of harmonic imaging.

Engineering Principles of Ultrasound
Lecturer: Prof Jeff Bamber

Principles and design considerations in echographic systems for anatomical imaging, transducers, signal and imaging processing, A-mode, M-mode, B-mode and C-mode scanning, mechanical and electronic scanning methods, frame rate and other limitations, artefacts, techniques for improving signal to noise ratio, harmonic imaging, 3D methods.

Principles, design considerations and limitations in systems for measuring / imaging blood flow and tissue motion, CW Doppler, pulsed Doppler, colour velocity Doppler, colour energy Doppler, transducers, signal and imaging processing, frame rate and other limitations, artefacts, techniques for improving signal to noise ratio, 3D methods.

Bioeffects and Safety
Lecturer: Dr Ian Rivens

Heating, stable cavitation, collapse cavitation, stasis formation. Significance of exposure parameters for damage mechanisms. Safety measures.

Quality Assurance of Diagnostic Devices
Lecturer: Mr Mark O'Leary

Safety (acoustic output) measurements: Purpose of measurements, methods of measuring acoustic pressure in water (needle and membrane hydrophones and their properties, sources of error on hydrophone measurements, experimental methods including scanner settings, equipment, and data analysis). Derivation of pressure, frequency, pulse duration and other parameters. Principles of measurement of p+., p-, I(SPTP), I(SPTA), I(SPPA) & I(SATA) and acoustic power. Difference between scanned and unscanned systems. Measurement of acoustic power using radiation force balance. Concept of *in situ* acoustic output values.

Performance (image quality) measurements: Purpose of measurements, equipment and test methods for both pulse-echo and Doppler systems. Pulse-echo QA includes tissue-equivalent gelatine and rubber phantoms, checks of element drop-out, calliper accuracy, resolution, and sensitivity. Doppler QA includes string and flow phantoms, velocity measurement accuracy, direction discrimination, spectral broadening. Summary of the limitations and future of ultrasound Quality Assurance.

Ultrasound Research Projects

Organiser: Mr Mark O'Leary
Presenters: Ultrasound Teams

Presentations of state-of-the-art scanning techniques and research, including general imaging, elasticity imaging, and current research projects.

Fields of Application – Ultrasound in Radiotherapy

Lecturer: Dr Emma Harris

This talk describes the use of ultrasound in radiotherapy, specifically for radiotherapy guidance. It will cover the technology, current topics of research, worldwide and in particular at the Institute of Cancer Research and Royal Marsden NHS Trust.

Virtual Hands-on Session

Organiser: Mr Mark O'Leary
Demonstrators: Ultrasound Teams

Basic measurements and quality assurance (including hydrophones, radiation force balance, attenuation measurement and quality assurance phantoms)

Quiz

Organiser: Mr Mark O'Leary

Informal multiple-choice quiz on the following topics: Physical and Engineering principles, Bioeffects and Safety, and Quality Assurance.

Quiz Answers and Question and Answer Session

Lecturers: Prof Jeff Bamber, Dr Ian Rivens and Mr Mark O'Leary