WARSAW UNIVERSITY OF TECHNOLOGY
DEVELOPMENT PROGRAMME

Centrum Studiów Zaawansowanych PW
Center for Advanced Studies WUT

MEDICAL IMAGING: IMAGE ACQUISITION, PROCESSING AND CLINICAL APPLICATIONS

by

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A five day short course (4 hours per day)
Monday, 24th October – Friday, 28th October, 2011
10:00am - 12:00am & 2:00 - 4:00pm

Lecture co-financed by the European Union in scope of the European Social Fund

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ABOUT THE COURSE

The course provides a detailed account of the data acquisition, image processing methods and clinical applications associated with the principal medical imaging technologies, including Computed Tomography, Magnetic Resonance Imaging, Ultrasound and Nuclear Medicine. After providing an introduction to the principal historical developments in the field, the course considers the scientific background and physical models used to describe the interaction of different forms of radiation with the human body and the way in which these models are used to design computer algorithms to construct a medical image and define specific Digital Image Processing (DIP) problems. The numerical solutions to such 'problems' are then addressed using an approach that is designed to provide delegates with an understanding of the relationship between the physical principles of how medical images are generated and the DIP algorithms that are used to interpret them in terms of the clinical information that they convey. The course is based on the book *Digital Image Processing,* by J M Blackledge, Horwood Scientific Publishing, 2005 which is available from: http://eleceng.dit.ie/papers/103.pdf and involves 20 contact hours, including presentations and tutorials and will require interested delegates to complete an examination and undertake self-study assignments equivalent to 5 ECTS.

DELEGATES WILL

Understand the basic principles of radiation physics; comprehend the fundamental mathematical models that are used for data acquisition and its transformation into a digital image; develop the computational algorithms used for simulating, reconstructing and processing medical images for clinical applications; implement image analysis methods for diagnosis; appreciate the role that medical imaging has in new generation health care.

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COURSE CONTENT

History and Background	**Mathematical Models and Methods**
A brief history of medical imaging. Basic radiation physics. Optical imaging. Thermal imaging. X-ray radiography. X-ray diffraction and the structure of DNA. Nuclear medicine. Ultrasonic imaging.	The imaging model. Convolution and correlation. The Fourier transform. The convolution theorem. Frequency space image analysis. Image reconstruction methods. Image processing methods. Image analysis.
Computed Tomography (CT)	**Ultrasonic Imaging**
Principles of CT. Data acquisition techniques. The Radon transform. Filtered back-projection. The central slice theorem. Image reconstruction algorithms. Image processing techniques in CT. Diffraction tomography. Clinical applications. Emission tomography and applications.	Introduction and background. B-scan imaging. The ultrasonic equations. Solutions to the ultrasonic equations. The ultrasonic signal equation. Simulation of B-scan images. Speckle and noise. Image processing methods. Flow imaging. Three-dimensional ultrasonic imaging.
Magnetic Resonance Imaging (MRI)	**Medical Image Analysis**
Basic principles of magnetic resonance. The Bloch equations. Solutions to the Bloch equations. Magnetic resonance imaging in k-space. Image sampling methods. Contrast mechanisms in MRI. Diffusion weighted MRI. Clinical Applications.	Statistical image analysis. Segmentation methods. Pattern recognition. Texture analysis. Expert systems development. Dynamical modeling and growth analysis. Medical imaging and Telemedicine. e-Health applications.

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