ECE 802-MI Medical Imaging

Michigan State University – Department of Electrical and Computer Engineering
Fall 2006 Syllabus

Prerequisites: Graduate Standing in Engineering, Math, Physics, Chemistry or related field. Experience with computer programming (using Matlab) is required. Some understanding of signal processing and Fourier transforms is expected.

Instructor:
Dr. Robert J. McGough
Email: mcgough@egr.msu.edu
Office: 1213EB
Office hours: Mon./Weds. 3:30-4pm and 5:30-6pm

Lecture times: Mon./Weds. 4:10-5:30pm

Required Text:
The Essential Physics of Medical Imaging (2nd Edition) (Hardcover)

Supplemental Texts (on reserve):
Medical imaging systems, Albert Macovski
Diagnostic ultrasound: principles and instruments, Frederick W. Kremkau.
Principles of computerized tomographic imaging, Avinash C. Kak and Malcolm Slaney.
Magnetic resonance imaging: physical principles and sequence design, E. Mark Haacke
Principles and practice of positron emission tomography, editor, Richard L. Wahl
Introduction to Biomedical Imaging, Andrew Webb

Course Objective:
The course objective is to provide the student with a basic knowledge of medical imaging systems, namely diagnostic ultrasound, X-ray imaging, CT, MRI, and PET/SPECT. This course will cover the fundamental interactions between different forms of energy and biological tissues, the signal and image processing techniques that are applied, and current clinical applications. In addition, the basic issues of resolution, contrast, acquisition time, and safety will be evaluated for each medical imaging modality.

Grading:
Homework 20%
Computer projects 20%
In-class presentation: 20%
Mid-term exam: 20%
Final exam: 20%
Topics Covered:

Ultrasound
Fundamentals of acoustic wave propagation (2 lectures)
Ultrasound diagnostic methods (3 lectures)
New developments & image characteristics (2 lectures)
Biological effects of ultrasound (1 lecture)

X-ray /CT
Fundamentals of X-rays (1 lecture)
Generation & detection of X-rays (1 lecture)
X-ray diagnostic methods (1 lecture)
Biological effects of ionizing radiation (1 lecture)
Principles of Computed Tomography (1 lecture)
Projection & Reconstruction of CT image data (1 lecture)

MRI
Fundamentals of nuclear magnetic resonance (2 lectures)
Generation & detection of NMR signals (1 lecture)
Magnetic Resonance Imaging (2 lectures)
In vivo NMR Spectroscopy (1 lecture)
Contrast & Resolution in MRI (1 lecture)
Biological effects of electric and magnetic fields (1 lecture)

Nuclear Medicine: PET & SPECT
Fundamentals of radioactivity (1 lecture)
Radionuclide imaging systems & methods (2 lectures)
Characteristics of radionuclide images (1 lecture)
Internal radiation dosimetry & biological effects (1 lecture)