

ECE 802-MI Medical Imaging

Michigan State University – Department of Electrical and Computer Engineering Fall 2004 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

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Office: 1213EB

Office hours: Tues./Thurs. 4:30-5pm and 6:30-7pm

Lecture times: Tues./Thurs 5-6:20pm

Attendance is required

Required Text:

Introduction to Biomedical Imaging by Andrew Webb

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

other texts will be placed on reserve in the engineering library as the semester progresses

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 knowledge is based upon an understanding of the fundamental interactions between different forms of energy and biological tissues, and understanding of the signal and image processing techniques that are applied, and an understanding of current clinical applications. The course will cover the basic issues of resolution, contrast, acquisition time, and safety for each medical imaging modality.

Grading:

Homework and projects 60% (image formation projects could be worth up to 30%)

In-class presentation: 10%

Mid-term exam: 15%

Final exam: 15%

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)