

Course Title: Advanced Medical Imaging Physics

Course No.: MP331

Instructor: James Dobbins, Cristian Badea, Jeremy Dahl, and Chunlei Liu

Text: Lecture Notes

Credits: 3

Semester Offered: Fall

Recommended References: Jerry L. Prince, Jonathan Links, "Medical Imaging Signals and Systems", Pearson Education (Division of Prentice Hall), 2006

Evaluation Scheme: Each unit will be graded based on an exam, a class project done by team groups, and homework assignments (depending on preference of instructors). Each unit will count 25% of the grade. There will be no final exam. The class will be split into teams of an appropriate number of students (depending on enrollment). Each unit organizer will assign the teams topics on which to prepare a PowerPoint presentation (about 15 minutes). Thus there will be four presentations in the semester and each member of the team will present at least one of the topics. The topics could be review/discussion of advanced topics from the literature (chosen by the organizer/instructor) or perhaps a project using on-line simulation tools, etc, but the final output would be some sort of presentation for the team. The instructor will administer an exam for his unit in one of the class periods.

Course Outline: The course includes advanced topics in diagnostic imaging including linear systems theory, image quality metrology, digital radiography and mammography, new advances in three-dimensional imaging modalities, MRI, CT, ultrasound, and evaluation of diagnostic imaging methods. Prerequisite: MP 230 (BME 233).

The course will be taught in four different units:

1. Xray (including Mammography): Organizer: James Dobbins, PhD (684-7761)
2. Computed Tomography: Organizer: Christian Badea, PhD (684-7509)
3. Ultrasound: Organizer: Jeremy Dahl, PhD (660-5574)
4. Magnetic Resonance: Organizer: Chunlei Liu, PhD (681-4788)

The units will have 6-7 lecture periods of 75 minutes in length. Each unit will have a different instructor(s) with the lead instructor/organizer noted above.

List of Topics by week

Schedule: Class meets Tues & Thurs from 10:05am to 11:20am.

Introduction/Review

Tues 8/31/10, Overview of the course, review of diagnostic imaging and sampling theorem

Xray and Mammography Unit

Thur 9/2/10, X-ray clinical uses, detector types, image processing

Tues 9/7/10, Image quality metrics 1: MTF and NPS

Thur 9/9/10, Image quality metrics 2: DQE and measurement methods

Tues 9/14/10, Advanced digital applications: dual-energy, temporal subtraction, tomosynthesis

Thur 9/16/10, Mammography: clinical use, x-ray spectrum, digital mammography, breast tomosynthesis

Tues 9/21/10 (Exam)

Thur 9/23/10 (Presentations)

Project titles: TBA

CT Unit

Tues 9/28/10, Concepts in modern CT imaging (Badea)

Thur 9/30/10, CT applications (Badea)

Tues 10/5/10, CT dosimetry

Thur 10/7/10, Micro-CT (Badea)

(FALL BREAK)

Thurs 10/14/10 (Exam)

Tues 10/19/10 (Presentations)

Project titles: TBA

Ultrasound Unit

Thur 10/21/10, Ultrasound basics and beamforming

Tues 10/26/10, Harmonic imaging and correlation and random variables

Thur 10/28/10, Speckle statistics

Tues 11/2/10, Doppler imaging

Thur 11/4/10 (Exam)

Tues 11/9/10 (Presentations)

Project titles: TBA

MR Unit

Thur 11/11/10, MR system, pulse sequence and image contrast

Tues 11/16/10, Diffusion weighted imaging and image reconstruction

Thur 11/18/10, MR spectroscopy (Cecil Charles, PhD)

Tues 11/23/10, Functional MRI (Allen Song, PhD)

Thur 11/30/10 (Exam)

Tues 12/2/10 (Presentations)

Project titles: TBA