BMED 4786
Medical Imaging Systems: Physics, Engineering, and Applications

Instructor(s):

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Office Hours:

TBD

Meeting Times and Locations:

TBD

Catalog Description

Physics and image formation methods for conventional X-ray, digital X-ray CT, nuclear medicine, magnetic resonance and ultrasound imaging

Prerequisites:

PHYS 2212, CS 1371

Other Prerequisites:

Desire to learn, common sense, being able to enjoy challenges, ability to work alone and in a team, curiosity, aptitude to modify and control sleep habits, and, finally, some knowledge of digital signal processing and programming in MATLAB.

Course Objectives:

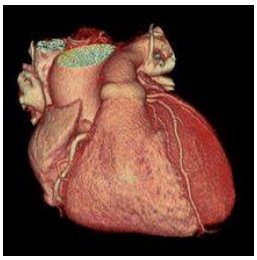
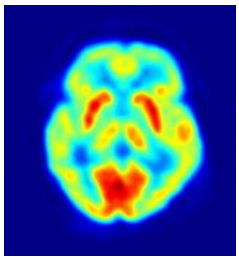
The main objective of this course is to introduce major biomedical and clinical imaging modalities including X-ray radiography, computed tomography (CT), nuclear medicine (SPECT and PET), magnetic resonance imaging (MRI), and ultrasound.

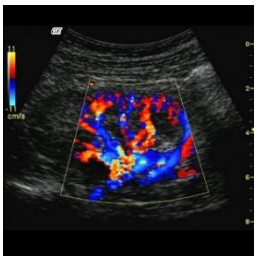
Course Description:

This course is an introduction to imaging systems. The main objective of this course is to expose you to the world of medical and biomedical imaging with emphasis on principles, approaches and applications of each modern imaging modality. For each imaging modality, the following approach is used: 1) describe basic physics; 2) develop a system model of the imaging system; 3) derive imaging equations; 4) describe hardware and software; 5) analyze signal, noise (sources), contrast, and primary artifacts; 6) discuss biomedical and clinical applications.

The course will be divided into three modules. The first module will cover X-ray imaging and Nuclear Medicine including computed tomography (CT), single photon emission computed tomography (SPECT), and positron emission tomography (PET). In the second part of the course, we will focus on nuclear magnetic resonance covering magnetic resonance imaging (MRI) and MR spectroscopy (briefly). In the final part of the course, ultrasound imaging will be introduced. Overall, fundamental similarities between the imaging equations of the different modalities will be stressed, and vital differences between different modalities will be discussed.





Topics Covered:

1. X-ray imaging and computed tomography
2. Nuclear medicine imaging
3. Magnetic resonance imaging (MRI)
4. Ultrasound imaging

Textbooks

Required:

Introduction to Medical Imaging: Physics, Engineering and Clinical Applications,
Nadine Barrie Smith and Andrew G. Webb. Hardcover, 264 pages, December 2002, Wiley-IEEE Press

Extensive lecture notes, review papers, tutorials, software, and other materials are available on the class web site: http://canvas.gatech.edu/

Supplemental/Optional:

The Essential Physics of Medical Imaging (3rd Edition), J.T. Bushberg, J.A. Seibert , E.M. Leidholdt Jr., J.M. Boone. Hardcover, 1048 pages, December, 2011 ISBN/ISSN: 9780781780575

Medical Imaging Signals and Systems, 2nd Edition, Jerry L. Prince and Jonathan Links
ISBN-13: 978-0132145183 ISBN-10: 0132145189 Prentice Hall, 2014

Imaging Systems for Medical Diagnostics Fundamentals, Technical Solutions and Applications for Systems Applying Ionizing Radiation, Nuclear Magnetic Resonance and Ultrasound, Arnulf Oppelt (Ed.) 2006, John Wiley & Sons Inc Magnetic Resonance Imaging-Physical Principles and Sequence Design, E.M. Haacke, R.W. Brown, M.R. Thompson, and R. Venkatesan, Wiley-Liss, New York.

Principles of Magnetic Resonance Imaging, A signal Processing Perspective, Zhi-Pei Liang, Paul C. Lauterbur, IEEE press.

Online resources:

Provided during the class, available at http://canvas.gatech.edu/

Teaching Approach

The students will attend three lectures (3 hours). There will be 4 homework assignments, several laboratories or field trips, and 3 projects covering all imaging modalities. In addition, there will be three midterm and final exams.

Attendance Policy

Attendance is required.

Grading & Evaluation

The course grade will be determined by homework (25%), class projects (30% total, 10% each), and three midterm/final examinations (45% total, 15% each).

Class Web site:

All materials for the class (announcements, schedule/changes, lecture notes, homework assignments, etc.) will be distributed electronically via course web site: http://canvas.gatech.edu/
You will be responsible for checking the course website regularly for class work and announcements.

Use of E-mail

In this course e-mail will be used as a means of communication with students. You will be responsible for checking your e-mail regularly for class work and announcements.
All students should become familiar with the Georgia Tech's official e-mail student notification policy. It is the student's responsibility to keep the Institute informed as to changes in his or her e-mail address. Students are expected to check e-mail on a frequent and regular basis in order to stay current with Institute-related communications, recognizing that certain communications may be time-critical. It is recommended that e-mail be checked daily, but at a minimum, twice per week.

Academic Integrity

Georgia Tech Honor Code: http://www.honor.gatech.edu
Each student must be vigilant of Academic Integrity at all times.
Academic dishonesty will not be tolerated and will be dealt with in as severe a manner as possible.