THE OHIO STATE UNIVERSITY
COLLEGE OF ENGINEERING

Medical Imaging and Processing

ECE 5206

Credit Hours:
3.00

Course Levels:
Undergraduate (1000-5000 level)
Graduate (5000-8000 level)

Course Components:
Lecture

Course Description:
Introduction to medical imaging techniques (CT, MRI, PET, ultrasound), including data collection, image reconstruction, physics of tissue interactions, and digital processing of medical images.

Prerequisites and Co-requisites:
Prereq: 3050 (352). Prereq or concur: 3090 or 582, or Grad standing in ECE, BiomedE, or Biophys.

Course Goals / Objectives:
- Master the basic the physical & mathematical principles of medical imaging modalities commonly used in clinical & research applications, particularly x-ray axial computed tomography, magnetic resonance imaging & ultrasound
- Master the design of computer simulation experiments to demonstrate the mathematical principles of image reconstruction. Instruction for computer experiment design is given in lectures and feedback is provided with graded projects
- Be competent at writing and presentation skills for the required written and oral report on a research topic selected by each student or student team and approved by the instructor
- Be competent in demonstrating professional and ethical responsibility in appropriately citing references in their reports
- Be familiar other imaging modalities and techniques for research projects, including but not limited to: x-ray angiography, single photon emission tomography, electron spin imaging, optical tomography and synthetic aperture radar

Course Topics:

- Topical summary
- Digital image mathematics: multidimensional FTs, DFT, circular symmetry, Hankel & Abel transforms, sampling and interpolation
- Axial computed tomography: Radon transform, central slice theorem, filtered backprojection (parallel and fan beam), iterative reconstruction, direct Fourier reconstruction
- X-ray CT: Basic physics of generation, photon absorption, attenuation; system configurations
- Nuclear magnetic resonance: basic physics, relaxation times, Bloch equations, spin echos, gradient recalled echoes
- Magnetic resonance imaging: Fourier imaging, spin echo sequence, gradient echo sequence, T1 and T2 weighted imaging, high speed imaging, echo planar imaging, spiral imaging, FLASH, SSFP
- Acoustics: physics, wave types, reflection and transmission properties
- Ultrasound imaging: propagation in tissue, scattered signal, A-mode imaging, B-mode imaging, M-mode imaging, diffraction and focusing
- Image processing: zero-padding and spatial interpolation, scanning window spatial filters (moving average, median, range), edge detection, intensity thresholding, morphometric operations
- Multispectral image processing: image registration, PET-CT, PET-MRI, combination of T1-T2-density MRI imaging.
- Student research report presentations

Designation:
Elective